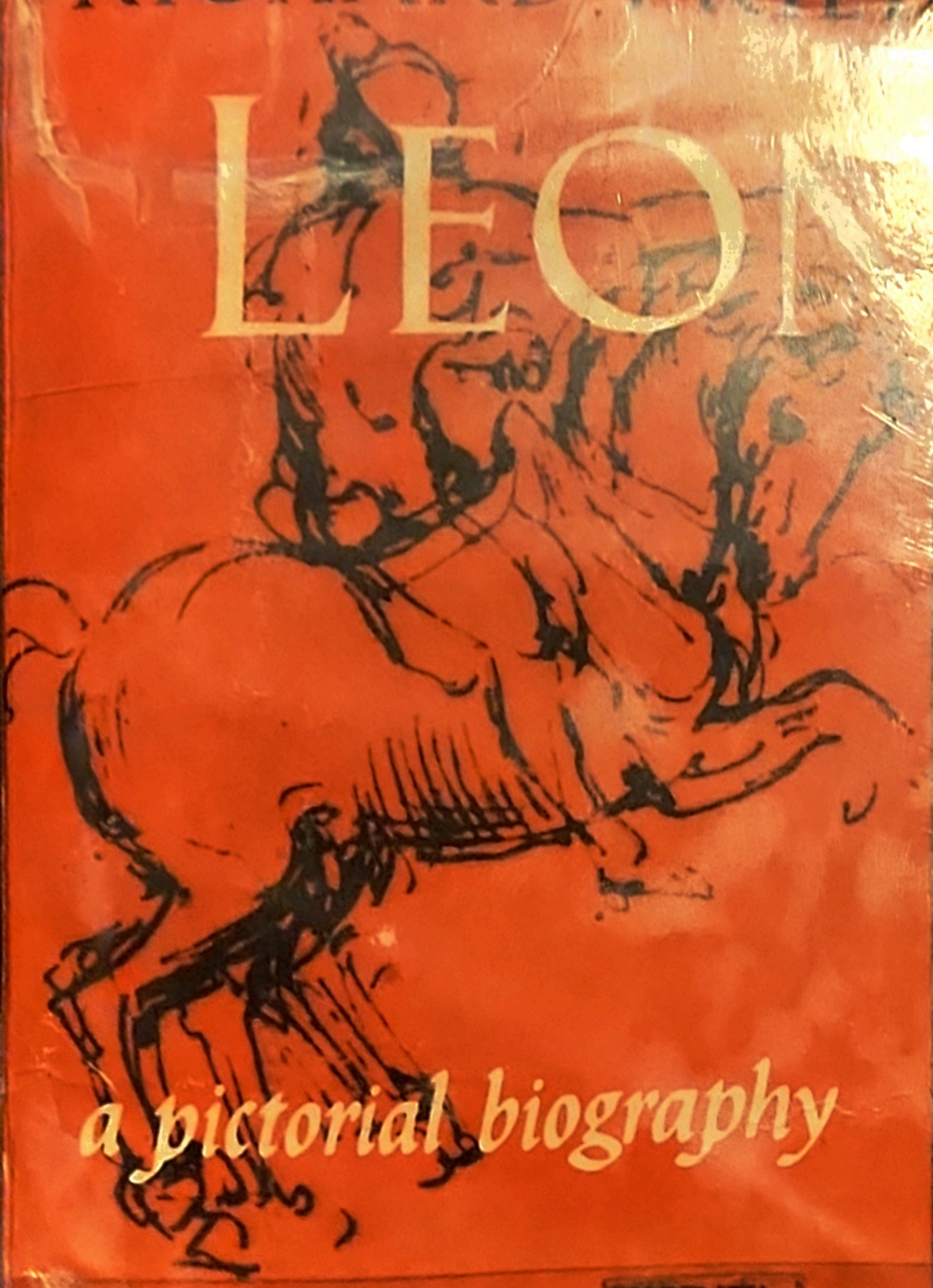
RICHARD FRIEDENTHAL

LEONARDO



a pictorial biography

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BY RICHARD FRIEDENTHAL

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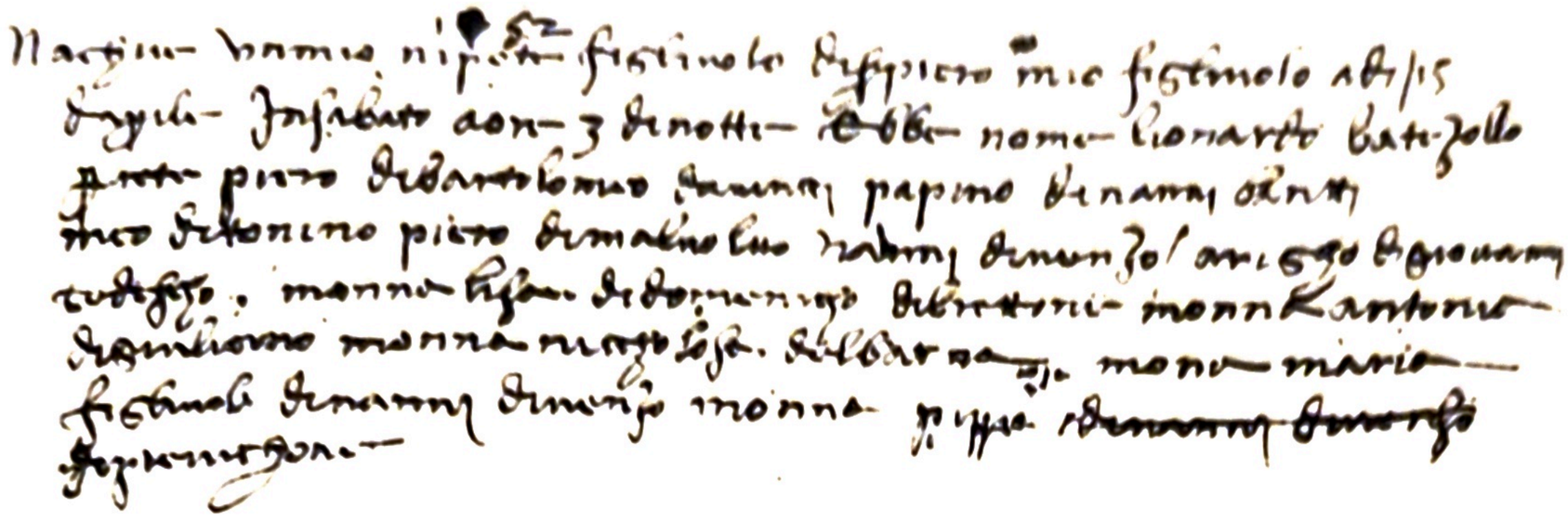


Entry of Leonardo's birth on 15th April 1452 (State Records, Florence)

Leonardo was born in the small town of Vinci, near Florence, in 1452, more than twenty years before Michelangelo and thirty before Raphael, with both of whom he is generally bracketed in the history of Renaissance art. At the time of his birth, the last vestiges of the Eastern Roman Empire were still in existence, though shrunk to one city, Byzantium, which was defeated by the Turks in the following year. In the West, the Holy Roman Empire was a mere shadow of its former self, while Italy was a confused tangle of republics, semi-republics like Florence, and states ruled by despotic princes, besides the temporal domains of the Vatican. France, more strongly unified, was preparing to launch the first attack of what was to become a European free-for-all. Leonardo's career cut clear across all these wars and intrigues. At various times he served the community of Florence, the usurper, Lodovico il Moro, of Milan, the republic of Venice, the Borgias. Moreover, he tried his luck at the papal Court, offered his services to the Sultan of Turkey and died in Amboise as a pensioner of the King of France. In the final analysis, of course, he was the servant of none but himself. And he served as a painter, sculptor, civil and military engineer, cartographer and technical designer. Yet after 1519 when he died at the age of 67, he was half forgotten in his own country, known only as a great inventor and the creator of two frescoes, the *Last Supper* in Milan, which was already beginning to peel away, and the *Battle of Anghiari* in Florence, which was also deteriorating from day to day. Only one man, his friend and pupil Melzi, realised the necessity of preserving his drawings, studies, plans, inventions, ideas and puzzles for the interest of future generations.

Vinci is a mountain-town. Its coat of arms shows a defensive tower, relic of its ancient independence, long since forfeited to Florence. Parts of the fortress are still in existence on the mountain-top, looming over the surrounding

The castle of Vinci, which is still standing

country with its vineyards and willow-trees *(vinci)* from which the town takes its name.

Leonardo's father, Ser Piero, was descended from a distinguished Florentine family which had practised the law for many centuries. It can be traced back as far as the thirteenth century; and descendents of one of the painter's brothers were still living in quite recent years. The family was sturdy and long-lived; Leonardo inherited its powerful physique for which, indeed, he was famed amongst his contemporaries. It was said that he could bend a horse-shoe with his bare hands. In Vinci Ser Piero possessed a country seat which is still shown to visitors, with its planes and olive-trees clustered round the entrance. The family was fairly wealthy; in an age when the machinery of government was little developed, the lawyer's office was an indispensable (and costly) stage in the proceedings through which all affairs of business or property had to pass.

His family

Leonardo's mother was the daughter of a small peasant; only her Christian name, Catarina, is known. Soon after his birth she surrendered her illegitimate son to his father's household and married a man of her own station from Vinci. She is never mentioned in Leonardo's notes.

Illegitimacy was hardly a stigma in this period; at least, Leonardo never suffered from it. He grew up in the house of his father and grandfather and remained an only child for many years. Ser Piero married four times, but only the third and fourth marriages produced any children, eleven in all. Leonardo came very little into contact with them except in connection with unedifying

It is believed that in this house near Vinci Leonardo was born

lawsuits between them as to their father's will and the estate of a deceased uncle. This uncle, Francesco, also lived in Ser Piero's house. The tax-records of the town remark, rather contemptuously, that he 'remains in the house and does nothing'; forty years later the same description of him was still given. But he nevertheless took an interest in Leonardo, for whom his father, always a busy man, had little time, and bequeathed him his modest property; it was about this that Leonardo became involved in a lawsuit with his step-brothers and sisters.

The boy could not have been unhappy. There was too much to see and discover — animals, of which he was always fond, plants, curious stone structures. His earliest memory was of a dream of a huge bird: 'I lay in the cradle,' he wrote, 'and it seemed as though a Kite descended on me. It opened my mouth with its tail feathers and moved them about between my lips.' He interpreted this as a kind of baptism by a symbol of nature seeking to speak through his mouth. 'And this seems to be my vocation, my fate,' he added in his note. His artistic gifts made themselves known early in his life. He drew, painted and modelled; and it is significant that the very first work of which anything is known shows all the characteristics of his later art and personality. The subject is a fabulous animal; to the end of his life he took pleasure in composing similar dragons and monsters. According to Vasari, Leonardo's first biographer, a farmer came to Ser Piero with a request to have a wooden sign painted. Piero's small son took the round, rather bent, object, had it planed by

The young Leonardo as St Michael in a picture by Botticini

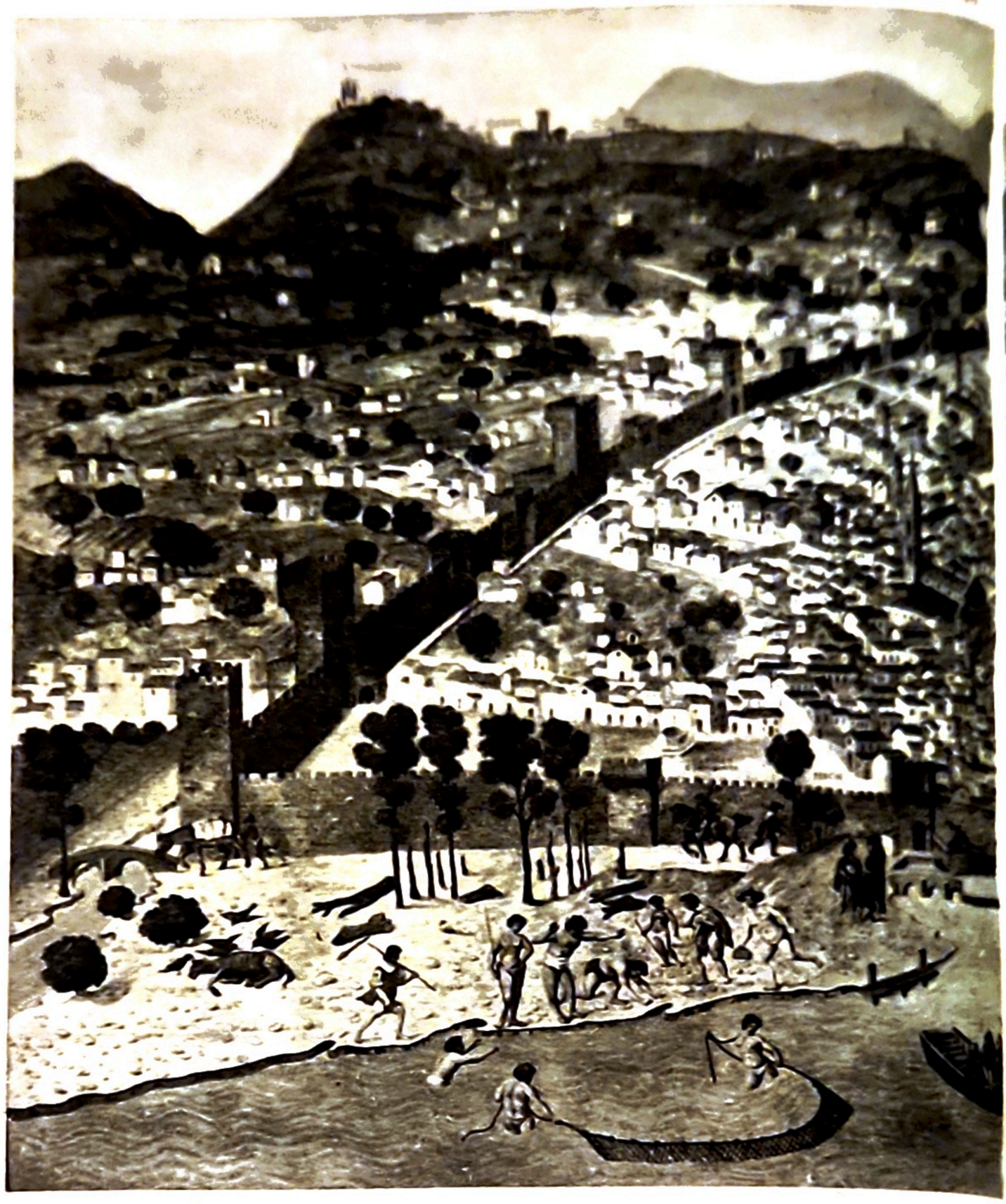
Battle between Dragons and Lions

a turner and primed the surface with plaster. He then collected together all the creatures he could find — snakes, bats, lizards — and took them to his room where they rapidly died. For some time he cogitated and racked his brains, searching for some gigantic idea, something which had never been seen before. Finally he decided on a Medusa shield and painted a dragon with poi-

An early work

soned breath issuing from its mouth, its sinewy body wriggling out of dark craggy rocks. Some time later his father knocked at his door. Leonardo asked him to wait and arranged his painting on the easel so that it was only half-lit in chiaroscuro fashion from the window. Startled, Ser Piero stopped in his tracks. Leonardo called out to him: 'That is how it is meant to be, Father. The thing is perfectly usable. Please take it.' Ser Piero praised his son, bought the farmer another sign more conventionally decorated with a heart and arrow, and sold the dragon for 100 ducats to merchants in Florence, who later disposed of it for three times this price to the Duke of Milan. This story is no doubt apocryphal but it contains all the elements of Leonardo's character and art: his extravagant preparations, plans on a scale far greater than the original project warranted, the rocky scenery of the picture, the chiaroscuro technique.

All the early records of the boy speak of his good looks and charm. There is no portrait of this period which can be certainly identified with him, but it is fairly probable that he was the model for the head of the Archangel Michael in Botticini's *Tobias and the Angel*, and perhaps also for Verrocchio's *Young David*. It was to Verrocchio that Ser Piero entrusted his son as a pupil after



Florence as it appeared in the 15th century. Most of the city's famous buildings still stand

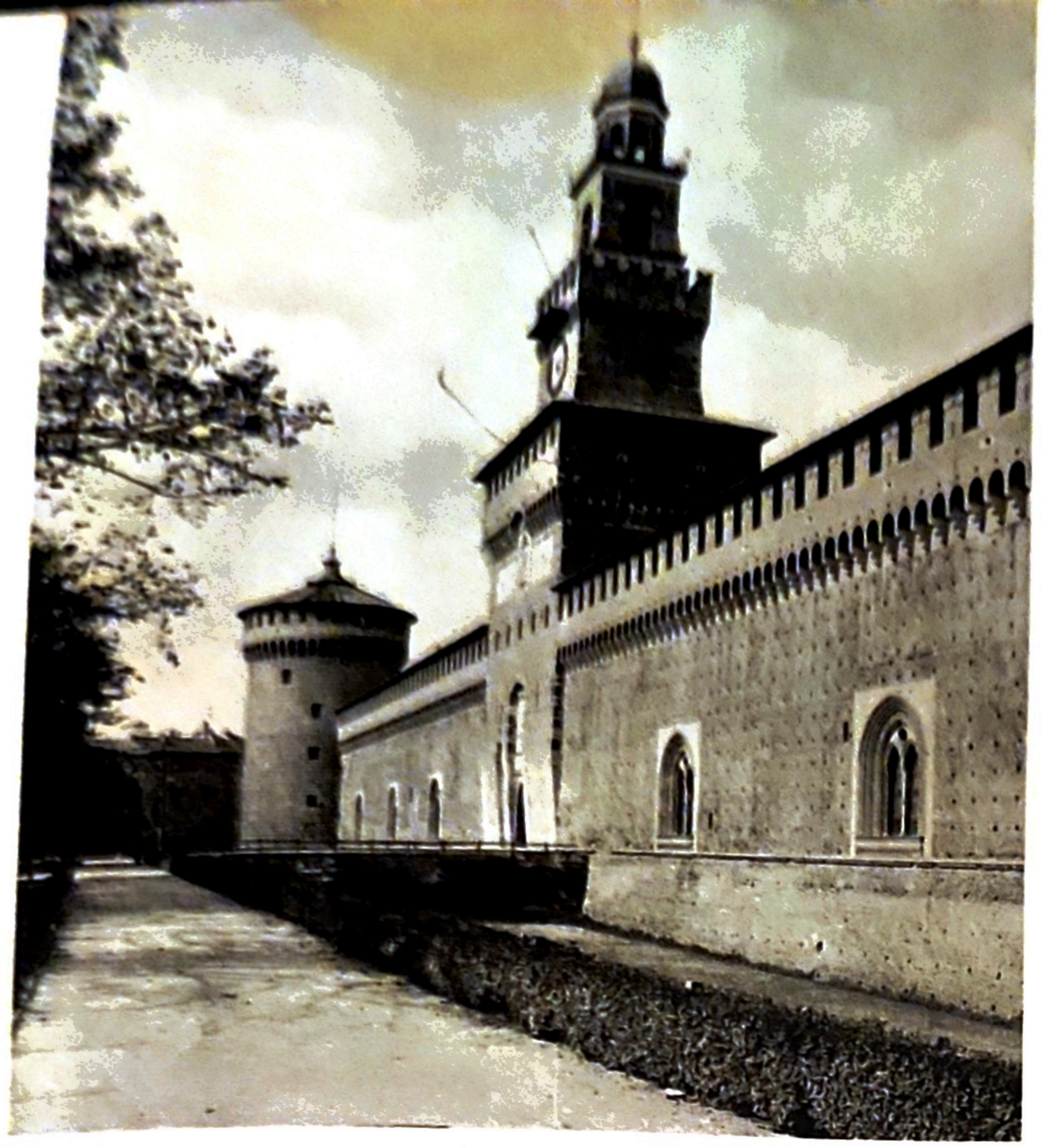
having, with a lawyer's caution, questioned him as to the boy's gifts. 'Do you think he will make his way as a painter?' 'I am sure of it,' replied the master.

Florence was rich but, as Leopold von Ranke, the nineteenth-century historian, says in his work on the Italy of the time, its citizens 'had not yet abandoned trade, the source of all this prosperity and power, together with its traditional hardness of character. They had 270 wool mills using wool from France, Catalonia and England (which provided the best quality) and sending their finished products to south Italy, Constantinople and, via Brussa, to the whole of the Orient. They had 83 'factories' for silk-goods, brocade and damask. The east sent them silk, the west wool; they processed both and then sent the silk products west and the wool products east, so providing for the needs of both halves of the world. Thus their first two 'signors' were cloth- and silk-dealers; the third was a money-changer.'

Cathedral

Pitti Palace (unfinished)

Leonardo joined Verrocchio as an apprentice in his workshop. The city of cloth-merchants and bankers had become the world's most renowned art-centre under the leadership of the Medicis who, although they held no official position in the republic, were nevertheless more powerful than their descendents, who styled themselves Grand-dukes of Tuscany. Verrocchio, whose real name was Andrea di Michele di Francesco da Cioni, had started as a goldsmith; he had taken the name of his master — 'the Andrea who studied with Verrocchio' — and was himself reputed to be 'one of the most highly considered teachers of every branch of the fine arts'. His portrait shows him to be a stocky man with narrow eyes and a hard mouth, and rightly suggests that he was a tireless worker accepting and fulfilling every commission that offered itself; he died, in fact, while working on his last great work, the equestrian statue of the Condottiere Colleoni in Venice. He had been stricken with a fatal chill after



Castello Sforza, the fortified 15th-century castle of the militant dukes of Milan

defence, such as ships which can withstand the force of the strongest opponents and produce dust and smoke.'

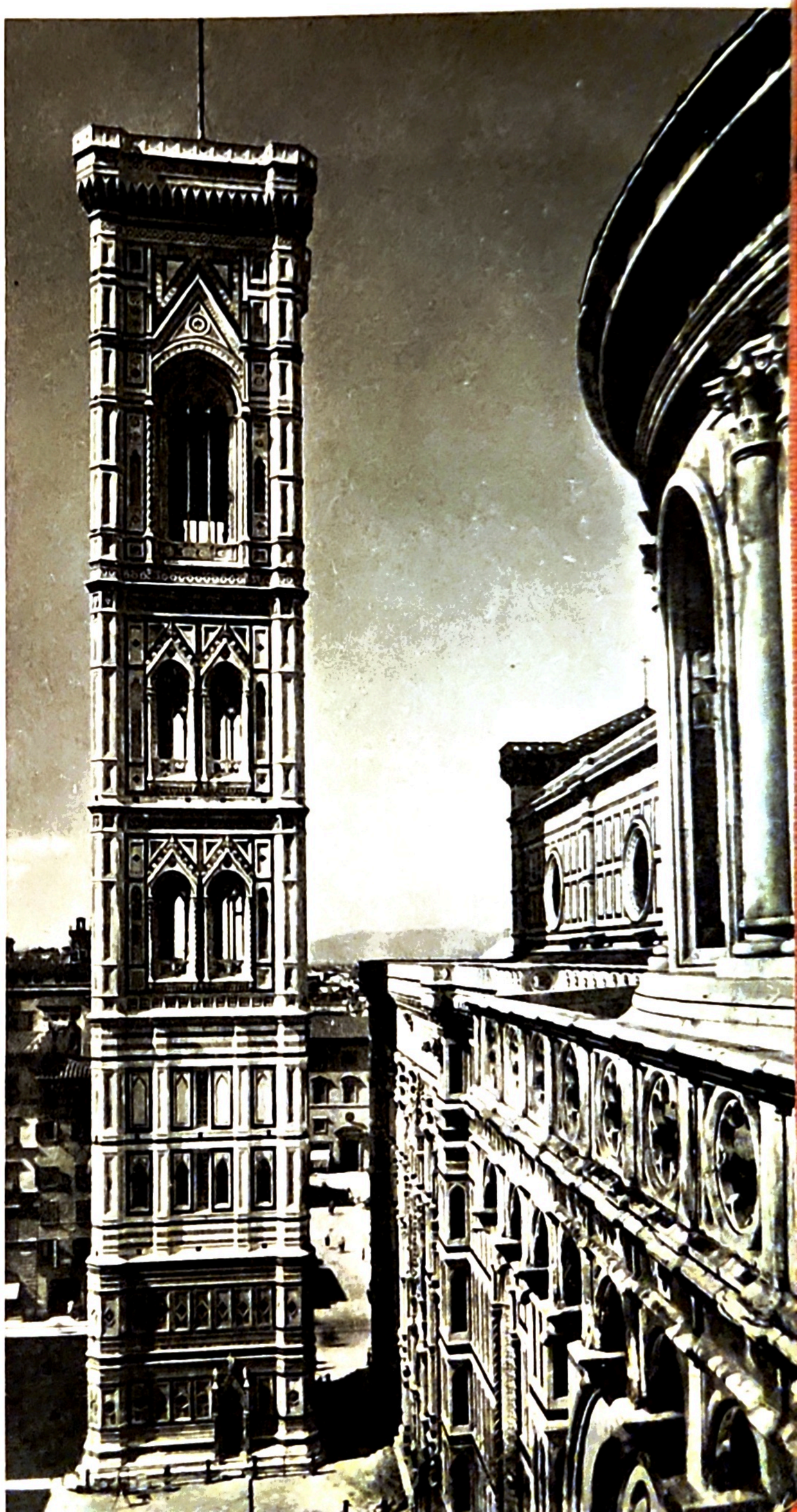
These were the basic points with which he recommended himself, adopting the rôle of a sort of alchemist specialising in the newest war methods; it is significant that the words 'easy' and 'convenient' occur again and again. At that time warfare was still slow, difficult and swiftly brought to a complete standstill by unexpected setbacks. Leonardo disregards all these considerations with the nonchalance of an artist, a dreamer, a dealer in fantasy — but in fantasy of the most detailed and carefully worked out kind. Finally, as the last of his ten points, he says: 'In time of peace I believe I can achieve something in architecture, as well as another, both in building public and private buildings and in channelling water from one place to another. Further, I work as a sculptor in marble, bronze and pottery and can paint as well as others with whom I may be compared. I could also add my labours to the bronze horse which is to contribute to the undying fame and eternal memory of your father and the renowned house of Sforza . . .'

In Milan

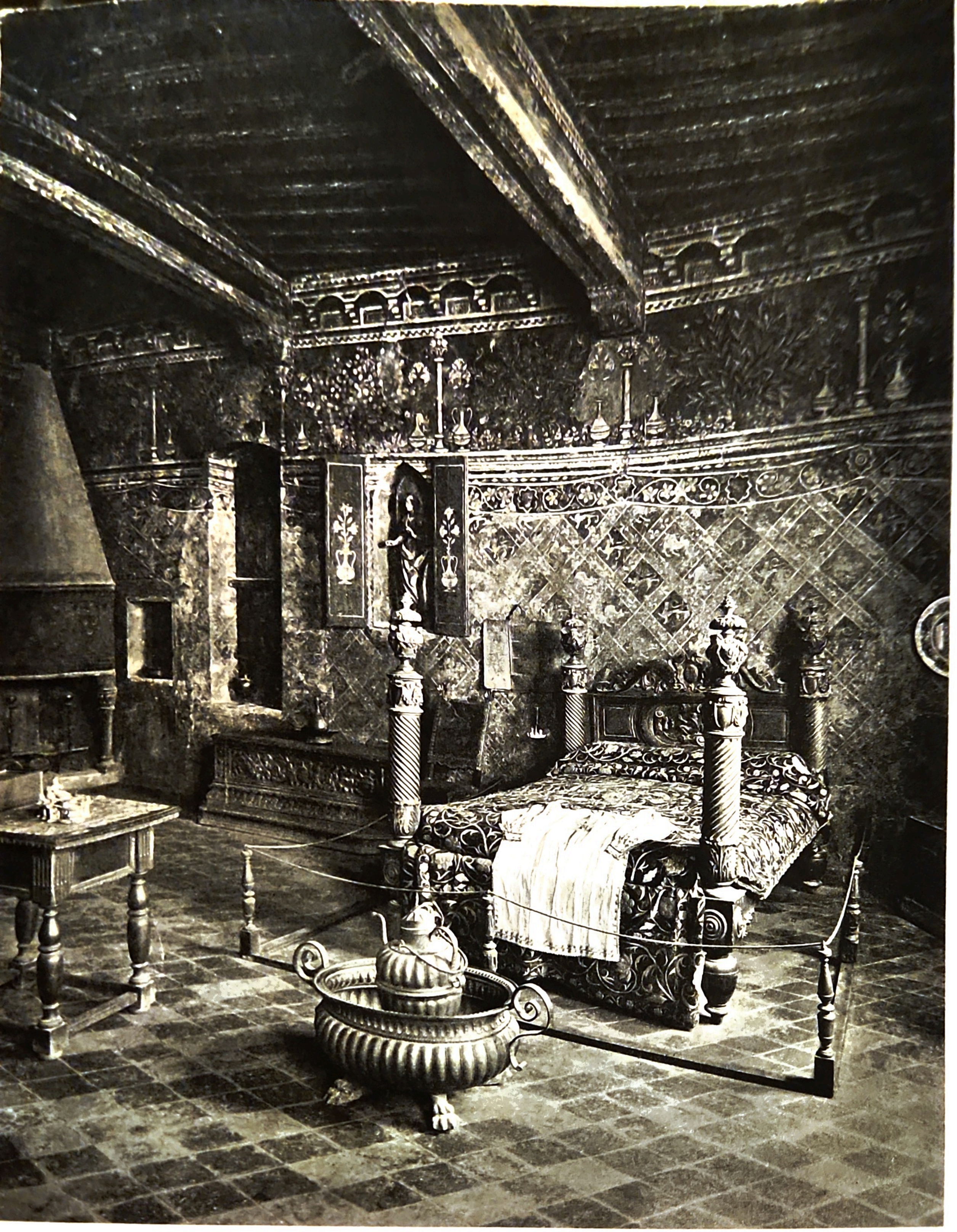
Leonardo was to work for sixteen years on the 'Great Horse', the equestrian statue to the founder of the Sforza family. But at first he introduced himself at Court in a very modest way. He brought with him a lute which he had made of silver so that it could compete with the more powerful wind-instruments. It was in the bizarre shape of a horse's skull: '. . . with it he outdid all the musicians who had gathered there to play.' His participation in festivities, parades and theatrical performances was the most important part of his work for the house of Sforza, apart from the giant project of the statue, which never got beyond a model. The war-machines which he suggested with such confidence also remained plans and projects; not a single armoured vehicle or siege-engine

whenever you desire and hope for good results from the things which I shall now briefly describe . . .'

Here follows a catalogue of war-machines, siege methods, armoured vehicles and nautical apparatus: 'First: I have a means of making very light bridges which can be very easily transported . . . And I have others which are proof against fire and are thus indestructible in battle, easy to take down and put up again, and I also know of a means to get fire to the bridges of the enemy and destroy them. Secondly: In besieging a place I know how to cut off the water in the dikes, also how to construct many drawbridges and other apparatus necessary for such an undertaking. Thirdly: If during a siege the engines cannot be effectively used on account of the height or strength of the town wall, I have a means to destroy every tower or fortification . . . Fourthly: I know of a kind of siege-engine which is very light and easy to move and which can be used to hurl fire-bombs. Their smoke will terrify, confuse and severely injure the enemy. Fifthly: I know how to construct subterranean caves and winding passages which can be made without any noise . . . Sixthly: I can make sound, indestructible armoured vehicles. If these reach the enemy with their cannons, they can compel the largest forces to retreat and afterwards the infantry can follow them in safety and without any let or hindrance. Seventhly: I can make, if necessary, bombards, mortars and other field-guns . . . Eighthly: Where cannons cannot be used I shall construct stone-throwing machines, catapults, slings and other instruments, amazing and hitherto completely unknown . . . Ninthly: If this should be necessary, I know of apparatus for use at sea for attack and



The campanile of Florence Cathedral, begun in 1336 after a design of Giotto's



State room of Florentine palazzo in Leonardo's day

finest creations of Florentine masters, whose manuscripts were beautified by the best calligraphers and miniaturists, a friend of writers and himself a writer, never gave Leonardo any commission whatever. It seems that Leonardo was known to him only as a young man with agreeable social talents, who could play the lute and might be considered as a candidate for decorative work for fêtes and festivals. As such he recommended him to the Court of the Sforzas in Milan; nothing is said of painting in his letter of recommendation. Leonardo went and Lorenzo never summoned him back. The Court of the Sforzas was renowned for its company of musicians, the largest after the papal singers in Rome. Leonardo introduced himself to the ruler of Milan with a letter in his own characteristic style: 'Your Gracious Highness! I have sufficiently seen and tested the productions of all those who are considered masters of the art of inventing war-machines. And since the working and function of these instruments is no different from that of the machines in common use, I shall endeavour — without approaching anyone else — to make myself clear to Your Excellency and reveal my secrets. I shall put them at your disposal

Sketch for
Adoration of the M
(Louvre, Pa

The Adoration
of the Magi
(Uffizi, Florence)

experience, the teacher of their teachers. These men strut about, puffed up and pompous, clothed and ornamented with the result of others' work, not their own, and give me credit for nothing . . .'

He borrowed quadrants and various other measuring instruments and immediately set about improving them. He constructed a water-clock and other time-measurers. He embarked on music, like his teacher Verrocchio, and promptly began to invent new, fantastically shaped and more powerful instruments. Mention is made of a superhuman engineering project: the foundations of the Church of S. Giovanni had sunk and he contemplated raising them by an entirely new method which would not harm the walls. He presented many models and drawings to the town council. 'And he convinced them of the worth of his plans with such sound reasoning that the affair seemed possible, although after he had left everybody saw that the undertaking was impossible to carry out,' reported Vasari.

There is no record of what he lived on during these years. He had abandoned the commission from the signoria. There was a pitifully small item, the painting of a church tower which was to be refreshed with new colour, for the monks of S. Donato, who shortly afterwards commissioned him to paint an altar-piece for the church. As a precaution it was stipulated beforehand that he should take no more than 30 months, and during the work the monks sent him provisions. The housekeeping account book states: 'To Master Leonardo: one keg of wine', and later, drily: 'Time elapsed and we bore the cost.' This picture, *The Adoration of the Magi*, is the only remaining work from this early period which is indubitably his, apart from the *St Jerome* which is incomplete and was only rediscovered, much damaged, at the beginning of the nineteenth century. The *Adoration* is also the only picture by his hand which is still unaltered, without any overpainting or important restoration of its surface at the present day. It is still rough in various parts, ranging freely over the whole gamut of the imagination. It never reached the point of being completed in colour. 'Time elapsed,' as the monks wrote and it was not only the monastery which bore the cost. For this picture, the conception of a painting rather than a finished product, was thirty years ahead of its time, an acute pre-vision of what painting was only to achieve at the turn of the century. It is brimming over with exciting figures and ideas; the careful preparatory sketches and large studies of single components hint at thoughts which Leonardo later embodied in the *Last Supper*. The picture sums up all he had learned until the point of painting it. It would have been epoch-making if it had not remained unknown, but it is due to this neglect that it has survived to this day in its original condition.

Leonardo was given no more commissions in his native town. Lorenzo il Magnifico, the great patron, whose state apartments were decorated with the

St Jerome with the lion
(Vatican, Rome)

and abysses and swallow them up so that heaven no longer has to suffer the sight of these cruel and pitiless monsters . . ?'

Technical projects

In the end the signoria did not commission Leonardo to paint the hanged Bandini. But in the same year, 1478, it ordered a panel for the chapel of St Bernard in the Palazzo Vecchio, giving him an advance payment of twenty-five gold marks. Leonardo never delivered the picture. He was already a vitcim of his own characteristic hesitation, indecision and the digressions into immense, superhuman plans which so reduced the number of works he completed, while ensuring that he left behind an enormous number of sketches and designs. There were his visionary engineering projects. He contemplated, for instance, diverting the course of the Arno to Pisa — a plan which not only demanded advanced technical knowledge but also involved political considerations and would probably arouse differences with the rival town of Florence. With his typical impartiality he noted down, side by side with sketches for pictures of the Madonna, ideas for war machines, scaling-ladders and gyro-wheels, which were to destroy any aggressor completely. He never altogether threw off these dreams and there is something quixotic, despite the greatness of his inventions, in his preoccupation with them. Florence, it is true, certainly came very near to being involved in war, so that the war-apparatus was no empty dream. The Pope, angered by the death of his nephew during the Pazzi affair, sent forth his troops. Their cannons roared eight miles away from the town. Lorenzo employed other artists, such as Giuliano de Sangallo, as military engineers, but he found no employment for Leonardo.

Now thirty years old, he was a solitary man though living in the midst of lively, sociable Florence. 'The painter or draughtsman should be lonely,' he said, 'so that physical comfort does not impair his intellectual progress, and in particular he should be alone when he is concerned with observation or reflection . . . When you are alone you belong completely to yourself, but when you are with one companion you are only half your own . . .'

Self-taught, he studied everything he could. He worked at mathematics. He conversed with great scholars. Toscanelli, the magician and doctor, who was one of the first to entertain the idea of a sea-route to India and sent a map to Columbus, is said to have worked with him. From him he received the first impulse to study geography; eventually he achieved a high pitch of perfection in drawing maps. He enlarged on his very scanty school education, noted down vocabularies, developed an individual, very crisp and fresh style, completely different from the pedantic heaviness of the scholars of the day. They seem to have been as contemptuous of him as he was of them: 'I am well aware that certain presumptuous people think they can slight me because I am not learned . . . But though I cannot, like them, quote from all the best authors, it is much better and more praiseworthy to be well-read in the book of

The tower of the Palazzo Vecchio in Florence. *Below:* the hanged agitator Bandini, drawn by Leonardo as a sketch for a wall painting

entirely unconcerned in the affair) was involved in the conspiracy, as was the archbishop of Florence, Salviati. The Medici could not be reached in their great town palaces — the 'palazzi' of the great and powerful families were true fortresses with thick walls and a lavish allowance of servants and retainers. But at church it was a different matter. One of the bandits hired for the assassination refused to have anything to do with a murder on holy ground

Two angels from Verrocchio's angels *Baptism of Christ*. The left-hand angel is attributed to Leonardo

tone to the picture. A new style was beginning.

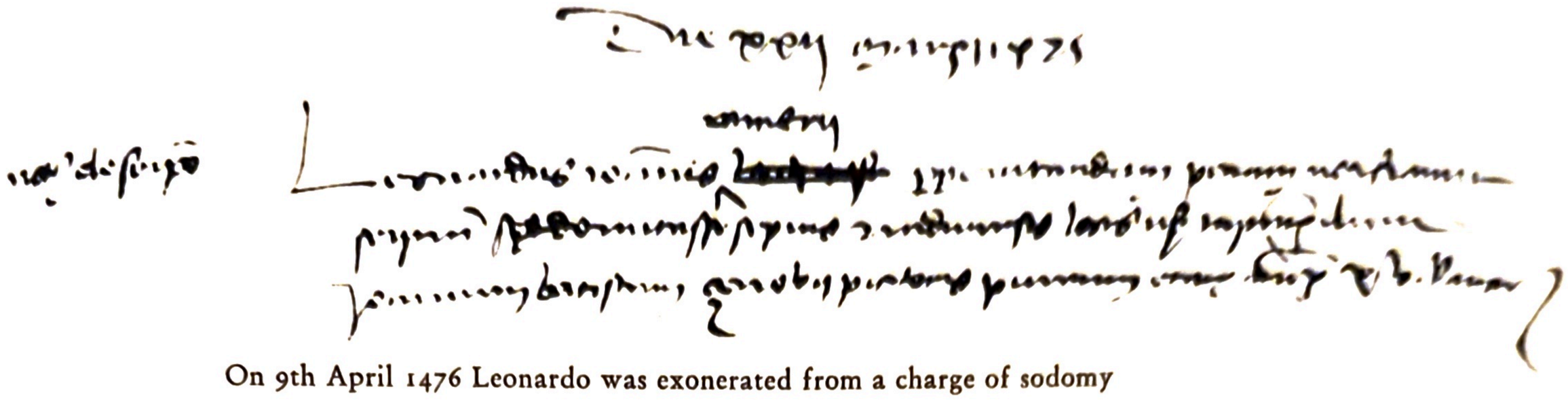
Taking this picture as a starting point, art-historians have extended the search for earlier and contemporary evidences of Leonardo's activities. In an *Annunciation* in Florence there is another angel painted with his characteristic charm and tenderness. He expressed himself strongly against the use of a hectic, 'dramatic' style for this sort of theme: 'I have seen an angel of the annunciation who looked as though he wanted to drive the Virgin Mary out of the room. He carried himself in such a way that you might think he despised her as a contemptible opponent. And the Virgin looked as though she were in extreme despair and would like to throw him out of the window.' That is not how she looks in this picture. She is gently raising her hand, the angel is prudently raising his, and a sort of dialogue seems to take place between the two sets of finger-tips. In fact the picture is an expression not only of a new style but of a new attitude. The same grace, youthful gaiety and feeling for lively movement can be seen in a whole group of drawings

of this period, pictures of the Madonna in which the baby does not sit stiffly on her arm but kicks about in a natural manner or plays with a cat while his mother bends smilingly over him. A number of such works have been attributed to him, besides various portraits, as for instance the head of a young woman with narrow, almost Mongolian eyes, outlined against the dark silhouette of a juniper-tree. The repelling sternness of the face and the coldness of the mouth indicate the authorship of Leonardo, who was never an admirer of women but found satisfaction only in the company of children, animals and inanimate nature. The hair, the delicate tones of the flesh and the eyelids are wonderfully painted, and the whole makes up one the finest portraits of the age; yet the picture breathes a curious hostility and strangeness.

From his time in Verrocchio's workshop there survive the records of a disagreeable lawsuit in which Leonardo was involved. In Florence there existed a special police surveillance of vice, and anonymous denunciations could be put in a box, or *tamburo,* in the Palazzo Vecchio. In April 1476 a denunciation was found in this box naming four young Florentine men including Leonardo and accusing them of a homosexual association with a seventeen-year-old boy, Jacopo Saltarelli, who had a rather evil reputation. The special police, whose organisation bore the curious name of 'Office for the Investigation of Nocturnal Traffic and Monasteries' took up the case — took it as far as an enquiry and ensuing arrest. Leonardo wrote to his friends and patrons for their support and designed instruments 'to open a dungeon from inside'. He turned to his father, who was at that time busy with the settlements for his third marriage and must have heard the news of his son's scandalous position with the greatest misgivings. When the case came to court Leonardo was acquitted but the experience left indelible traces on him. In his diaries he writes of the power of calumny: 'The tongue kills more men than the sword.'

Again and again, too, he returns to the subject of loneliness. He remained a

Madonna and Child,
pen drawing about 1480



On 9th April 1476 Leonardo was exonerated from a charge of sodomy

lonely man until his death, despite his social graces. He never had any close friends of his own, or even of similar, rank: there were only servants, like Salai, the light-fingered little rascal whom he took into his service in Milan and favoured with money and presents to the end of his life, or the faithful companion of his later years, Melzi. All the contemporary accounts of him agree that his mode of living was extremely simple, apart from his clothes; he ignored the fashions of the day and 'wore a short pink coat which reached to his knees, even when long garments were the fashion'. Much stress is laid on his elaborate care of his hair and later his 'long, curly and splendidly arranged' beard. He did not drink, ate sparingly (in later years only fruit and vegetables) and placed a great value on tidiness and cleanliness. In all his numerous notes of anecdotes and pranks there are none of the bawdy stories which were so popular in his age. Nor is there any mention of an attachment to the fair sex. In fact in one place he remarks with great insistence on the 'ugliness' of sexual intercourse and voices the opinion that through it man loses his dignity; man's nobility he associated only with facial beauty and the free working of his mind.

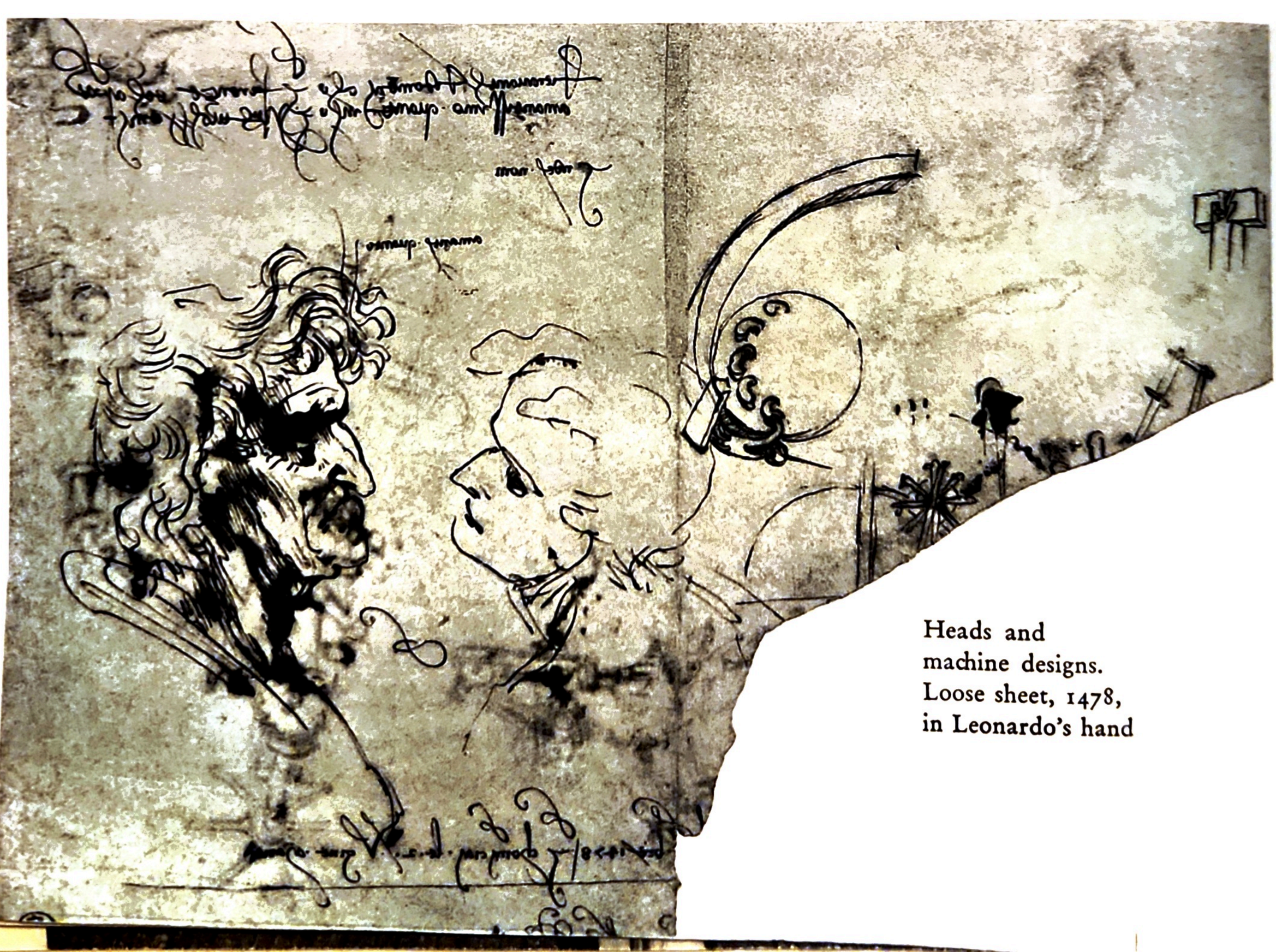
In his art this departure from the 'normal' attitude undoubtedly left its mark. There are unmistakable signs of a hermaphroditic outlook, sometimes almost a confusion of the sexes as in the late work, *John the Baptist*, a preference for the tender side of man and the boyish side of woman. But, as with other great men of the past, our knowledge on this subject can never be much more than conjecture.

There was another experience which made a strong impression on Leonardo and to which we owe one of his few drawings of the contemporary scene. The drawing referred to depicts a hanged man. It is not one of the studies that he later made in the execution square which at that time was almost the only place where corpses, otherwise held to be holy, could be procured for dissection. The corpse, no common criminal or sneak-thief, is hanging by a rope, wearing a fur-trimmed hood. His name, Bandini, is given on the drawing, as are notes of the details of his clothes: tan hat, jerkin of black satin and a blackish-red velvet collar on a Turkish coat trimmed with fox fur. Bandini, the main

conspirator in a plot of the Pazzi house to assassinate the Medicis, had been run to earth in Turkey and sent back to Florence for trial.

At this period, Leonardo was producing a large number of drawings, studies of boys' heads, old men — one of these is crowded with technical sketches for a well-wheel apparatus in which he was then very interested. These were all private ideas for themes and figures, rather than plans for a particular picture of commission. The drawing of Bandini, however, was intended for a purpose. Pictures of the various conspirators were to be painted on the wall of the town hall and shine forth as a dreadful warning. The first men arrested had been painted hanging upside down by Botticelli, who received a large fee for his work. Bandini, however, was not arrested until a year later and Leonardo hoped that he might be considered as a candidate for his portrayal.

The man's crime had stirred and shattered the town. For centuries there had been savage feuds between the Pazzi and the Medici, feuds which flared up on various pretexts from time to time and were almost impossible to extinguish. This particular attack was planned to take place in the cathedral during a high mass. The Pazzi were the Medici's main rivals, like them powerful bankers; they had contrived to be given the supervision of the Papal Court's financial affairs and now they prepared to administer the coup de grace to the rival house. A cardinal, nephew of Pope Sixtus IV (who himself did not seem to be



Heads and
machine designs.
Loose sheet, 1478,
in Leonardo's hand

Head of a warrior in ceremonial helmet

threw himself into his chosen calling with dogged energy, undertook every kind of work, even the most lowly, kept strictly to the path then considered fruitful and became a popular creator of uniformly neat church-pieces — a complete contrast to Leonardo. Then there was Lorenzo di Credi, a favourite with his teacher on account of his manual delicacy, which enabled him to produce an almost identical copy of any picture. Later he imitated Leonardo's manner for a while and produced pictures which can only be distinguished from his fellow-pupil's with the greatest difficulty.

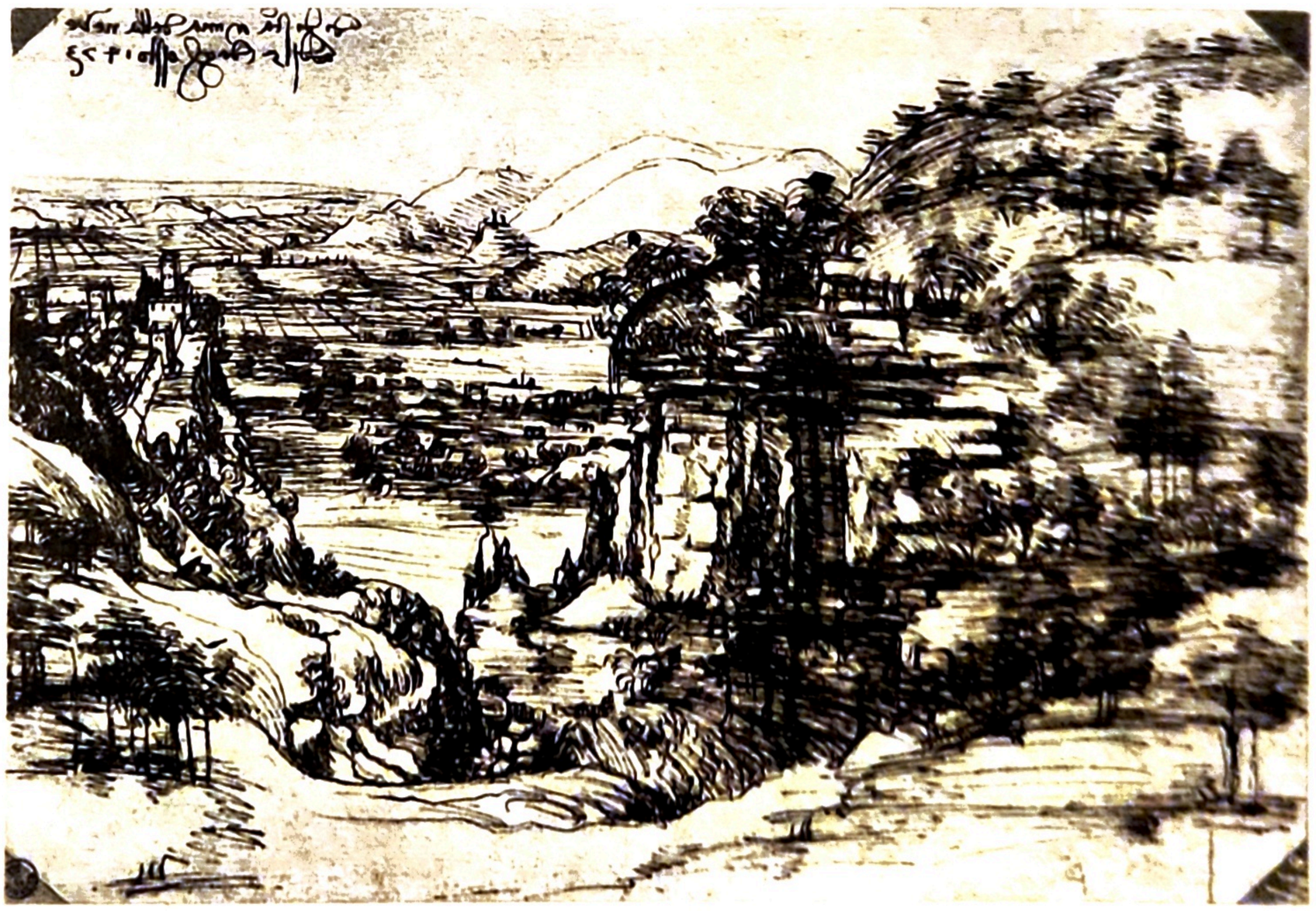
There were also purely technical skills to be learned. Verrocchio's workshop was commissioned to produce the great gilt copper ball which Brunelleschi, the architect, had decided should crown the dome of the cathedral of Santa Maria del Fiore and bear the cross. It was cast in eight sections which were gilded in the furnace and then soldered together. Leonardo reminded himself later to

'remember the solder with which the ball of S. Maria del Fiore was welded together.' The ball was placed in position, and consecrated with a Te Deum, on 27th May 1471; it is the first work in which he is known for certain to have taken part.

Verrocchio also took an interest in mathematics, the study of perspective, the newly discovered 'magic art' and 'alchemy of lines' which was circulating in Florence and which seemed to the artists of the day to provide a means of capturing the forms of the natural world with infallible 'scientific' exactitude. It was said of Paolo Uccello that, enthralled by these new discoveries, he murmured to his disappointed wife while half-asleep: 'What a wonderful thing perspective is!' Leonardo too was excited by this new art; mathematics was one of his passions; he was seduced, almost possessed, by the subject. But we should not confuse our word 'mathematics', with its overtones of classrooms and dusty Friday afternoons, with the word as then understood. At that time mathematics was the prerogative of the chosen few, with secrets to be kept and handed on as carefully as those of alchemy.

Verrocchio was also a musician, as the art was conceived at that time: that is, he sang madrigals and played the lute. Instrumental music was only at its beginnings. Leonardo also played the lute and his social talents were already well known. Verrocchio moulded hands and feet in plaster and made death masks. There is mention of a great battle-picture, with nude figures. Leonardo made studies of drapery with material dipped in plaster. He also travelled out into the Arno valley and drew landscapes; the first drawing by his hand is

In Verrocchio's workshop Leonardo worked on the golden ball for the dome of Florence Cathedral.



Arno scenery between Vinci and Pistoja. Drawing by the 21-year-old Leonardo

Sketches of heads
– they are presumed to represent relatives of Leonardo's

dated 1473, a year after he had been passed as a master in the matriculation examination of the St Luke guild of painters.

Another drawing, which is believed to contain portrait sketches of members of his family, shows his keen eye for the shape of a face and the curious contrast between some of his heads — caricature-like, almost grotesque — and others which are all tenderness and charm.

Then there is an angel's head which shines out from the *Baptism of Christ* painted in Verrocchio's workshop. The picture itself is stiff and unpleasing; Vasari speaks of Verrocchio's 'hard, harsh method,' achieved more by 'interminable study than natural gifts'. On the left kneel two angels, one with coarse features, the other sweet, lovely, with a profusion of curly hair and great grace of pose. As early as Leonardo's day it was recognised as his work, and the story was circulated that Verrocchio was so confounded by his pupil's success that he never again touched a paint-brush but restricted himself to the chisel. It is certainly true that he never painted after this date.

Even from the technical point of view this section of the picture is distinctive. It is painted in oils, the new painting technique imported to Florence from the Netherlands, and very little used at the time; the rest of the picture is in tempera. There are still further traces of Leonardo's brush; parts of the landscape have been recognised as identical with one of his drawings of the Arno valley, and he also painted over the body of Christ, bringing a new

a Pharaoh could have carried it out. If Leonardo's figures have been correctly deciphered, the chambers were to measure on an average about half a mile. We shall never know for whom he destined the project. He dedicated it to the 'unknown prince', the patron he never met. It could not have been Lodovico and indeed such a ruler was not to be found throughout Europe, whose princes were mostly poorer than the tyrant of Milan.

Architecture was his passion at this period and, with the characteristic quality which underlay his grandest dreams as much as the smallest details of daily life, he turned from this monster project to a practical building which was much more likely to interest either Pavia or Milan: a brothel. It was arranged on a novel plan, with three entries to obviate all embarrassment and enable the visitor to be completely unobserved. He next set about designing a stable, perhaps for the Court favourite, Severino, whose fine horses — 'a swift Spanish horse, a Sicilian' — he had remarked upon while making his studies for the equestrian statue. The stable was a sort of palace for horses, cleaner than anything hitherto known. 'Contrary to the customary usage,' he wrote, 'drainage pipes are provided under the floor. The hay falls automatically through funnels into the mangers.' He drew churches linking Milan and Pavia with a chain of four eight-domed chapels, thickly clustered like the Russian onion-domes which he had, of course, never seen. He designed houses with two sets of steps and double spiral staircases. He even went beyond single buildings and designed whole towns.

The plague had decimated Milan; in two years it had disposed of almost a third of the population. Leonardo soon grasped the basic problem: the lack of sanitary arrangements. There were dungheaps in the streets, the steps and arcades were used as public latrines and even the palaces of the nobles stank abominably. And the excessive use made by both men and women of perfume was no solution to the problem. He beset Lodovico with plans which envisaged a basically new Milan. Not only would the town itself have to be altered; he suggested 'satellite towns' in the more distant neighbourhood, an idea only lately taken up again by town planners. 'Give me the necessary authority,' he told Lodovico, 'and eternal honour will be yours. You will have five thousand houses with thirty thousand inhabitants in ten towns; thus we shall distribute the people now crowded together in huge masses, huddled together like flies on top of each other, filling every doorway with stench and offering an easy prey to pestilence and death.' He devised lifting gear, to be operated by air-pressure, which would carry water up to the top floors of houses. He planned new methods of heating — stoves, ovens, mechanical spits turned by hot air. Ever preoccupied with the idea of cleanliness, which was so unusually important to him in his personal life, he sketched lavatories with revolving windows regulated by counter-weights. And then there were automatic doors,

Leonardo's unfinished
Portrait of a Musician

The condottiere Colleoni
by Verrocchio

working in the fierce heat of the furnace on the final casting of the work. One of Leonardo's earliest drawings is thought to show the head of the Condottiere (who in reality looked more like a morose, wrinkle-browed businessman, which he in fact was, than a condottiere, or general) transformed into a fantastic study — with features that are almost reminiscent of his later caricatures.

With Verrocchio

But first he had to work his six-year apprenticeship, as prescribed by the guilds and companies, before he could be thought of as a 'master' of his art, a painter in his own right. He was set to work on tombs on which several craftsmen collaborated, silverware, mosaic work, bronze statues, church pieces; it was in Verrocchio's workshop that Leonardo learned the fundamentals of his technical knowledge. In the circle of his fellow-pupils and apprentices there were many who remained mere hacks, but others developed into independent artists, like Pietro Perugino, a few years older than Leonardo, who

The Madonna of the Rocks in the National Gallery, London. A second version of this picture is in the Louvre.
Right: head of the angel on the Virgin's left

asked why his own children were so ugly and his painted figures, which were after all lifeless objects, so beautiful: 'I make my pictures during the day and my children at night.' He designed the decorations for the wedding celebrations of Gian Galeazzo, the rightful duke and Lodovico's prisoner. The domed hall of the castle was transformed with green branches into a wooded arbour. There were dances, ballets, masquerades and equestrian feats in Turkish costume. At midnight began *The Paradise*, an allegorical production by the Court poet Bellincioni, for which the scenery, a kind of planetarium gilded and glittering with stars, was designed by Leonardo. In various niches stood figures representing the seven planets. Mercury then descended and congratulated the bride, accompanied by the graces of the pagan cosmos, and the seven virtues of the Christian one.

Leonardo frequently worked on the designs for such occasions, as for instance at the marriage of Lodovico to the sixteen-year-old Beatrice d'Este, whose sister Isabella was the only one of all the Court personalities to take a serious interest in Leonardo and beg both by word of mouth and by letter for pictures from his hand. In the event, however, he never painted anything for her.

Even in his latest period, when at the Court of François I in France, he still

sought to recommend himself to the Court with *pièces d'occasion* and devices of various kinds. On one occasion he arranged for a knight clothed in gold to present an enormous golden heart which opened to reveal a sphere bearing a two-sided figure, one side strong and handsome, the other lean and sad with tears falling over its wasted cheeks. Leonardo wrote in his notes that it represented 'joy and sorrow, which are never apart'.

Several illustrations of the Milan festivities survive, stable-boys dressed as 'wild men', a sketch of the set for a play, *Dafne*, and a series of very beautiful figures which seem more appropriate to *A Midsummer Night's Dream* than to one of Bellincioni's frigid allegories.

One or two pictures surviving from this period have been more or less certainly identified as portraits by Leonardo of members of Court society. The one most probably by him is the very beautiful picture of a young woman with an ermine in her arms. She has been identified as Cecilia Gallerani, one of Lodovico's many mistresses. She came of a good family, spoke fluent Latin, or so the Court poets stated, wrote poetry, sang and forged a brilliant path through the labyrinth of Court life. Something of this clear-headed courage can be seen from her face as shown in the picture, the firm mouth with only the faintest shadow of a smile, the energetic pose of the head. A curious touch is the presence of the ermine, the animal whose description Leonardo had transcribed from a medieval 'bestiarium', or natural history: 'It allows itself to be caught by the huntsman rather than run into a dirty hole, and all because it will not sully its loveliness.' The Court poet, Bellincioni, wrote a sonnet on the 'Portrait of Madonna Cecilia, painted by Maestro Leonardo', embodying the fashionable conceit about Nature being jealous of her lifelike copy. It contained one line peculiarly appropriate to the attentive, tense expression in the portrait: 'She listens but she does not speak.'

If Leonardo had hoped to gain further employment at Court through this picture, he was to be disappointed. He received a few small commissions, some from other quarters. The still incomplete cathedral, for instance, was to have a dome; Bramante had already constructed a model but had got no further, and it was handed over to Leonardo, who also never finished it. Another task took him to Pavia where he was to act as consultant during the building of the cathedral there. He was deeply impressed by the statue of Gisulf, king of the Goths, which he saw standing in the square before the church: 'The attitude of the monument in Pavia is more wonderful than anything else; the horse's trot seems almost like reality,' he noted. The classical amphitheatre, the first he had ever seen, attracted him and turned his mind to new grandiose plans for a 'theatre in which to celebrate mass' with three aisles and a pillar in the middle to act as a pulpit. And as though driven on, almost infected — his reactions were often like the onset of a fever — he designed a mausoleum which should

Lady with the Ermine
Cracow

Young Milanese woman. Drawing
of the school of Leonardo,
attributed to Boltraffio

Stage figurine,
sketch of Leonardo's for Court
celebrations at Milan

surpass all the buildings of antiquity in size and splendour. It was to be set on an artifical hill, a pyramid of earth up which three stairways would lead, and have three great vaults, besides hundreds of urns for the race which was to find a resting-place there for centuries to come. The chambers were to be made of granite, a stone that resists the damage caused either by time or human agencies. There is something Eygptian in this plan, and certainly only

exceeded the costs agreed upon. Instead of eight months he worked on the picture for nearly twenty years, making two versions, of which one is now in Paris and the other in London. Instead of the theme which the monks had carefully worked out to an agreed theological scheme, he elaborated a free fantasy on a religious ground bass. In the original version there were no haloes over the figures. Their hair shone and they were treated with a tenderness and almost sensual love, unlike anything produced before. The heads gleam and shimmer in front of the mysterious grotto which looms up like a natural cathedral in the background. The positions and gestures are freer and more supple than had ever previously been attempted. And yet the whole, influenced by Leonardo's scientific tastes and outlook, rests on a mathematically worked out framework, a triangle, or perhaps two concentric contrapuntal triangles. The charm and revolutionary novelty of the picture derive from this interplay of strict composition and lively balance of movement. Apart from Leonardo, this effect was not achieved until the next generation with which Leonardo, although so much older, is usually classed.

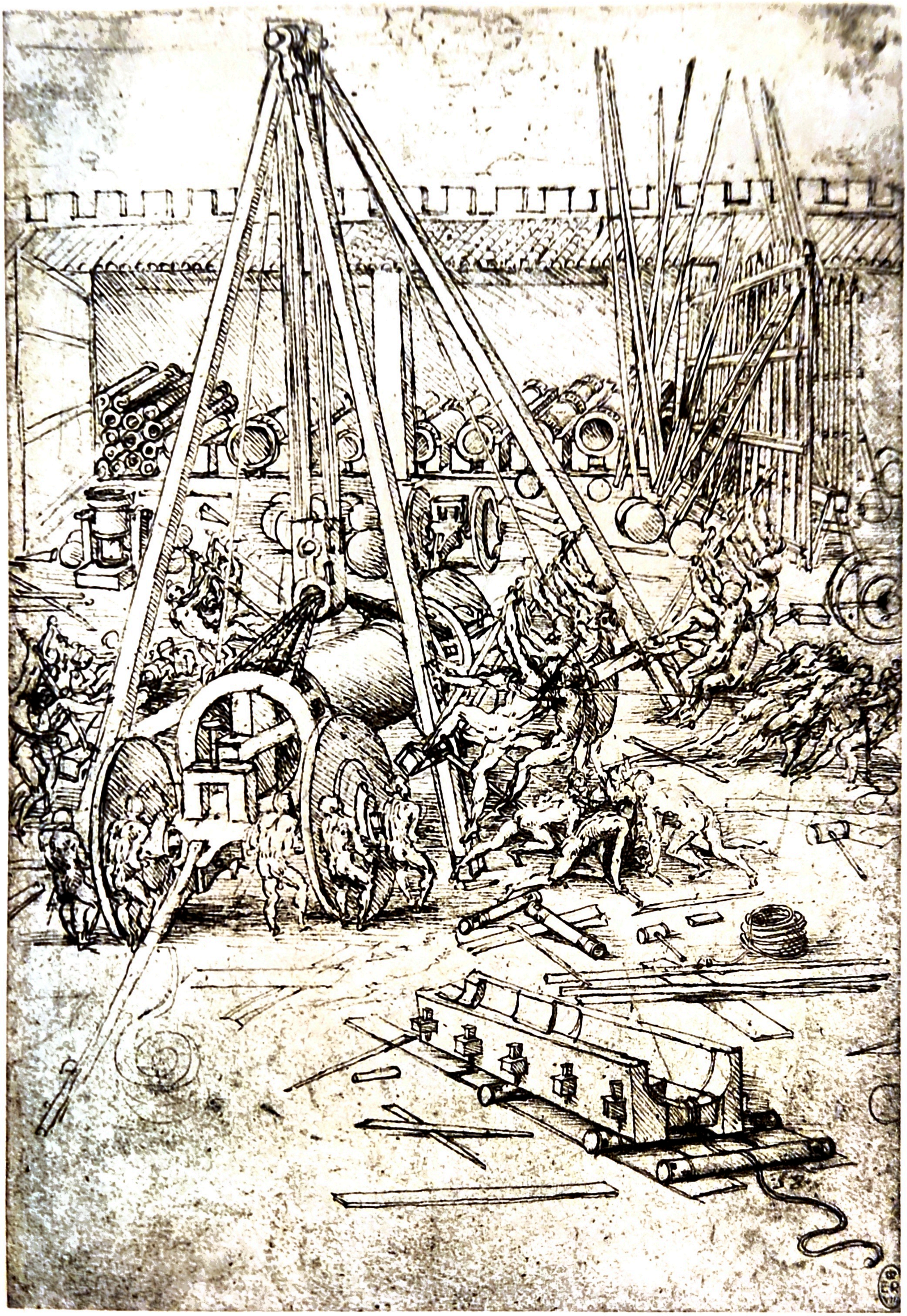
The angel, who in the first version points stiffly and didactically at the Christ Child as the monks had stipulated, in the second gazes pensively, almost dreamily, into the distance. Some of his radiance shines on to the side panels of the work on which were Ambrogio de Predis' pictures of two angels playing instruments.

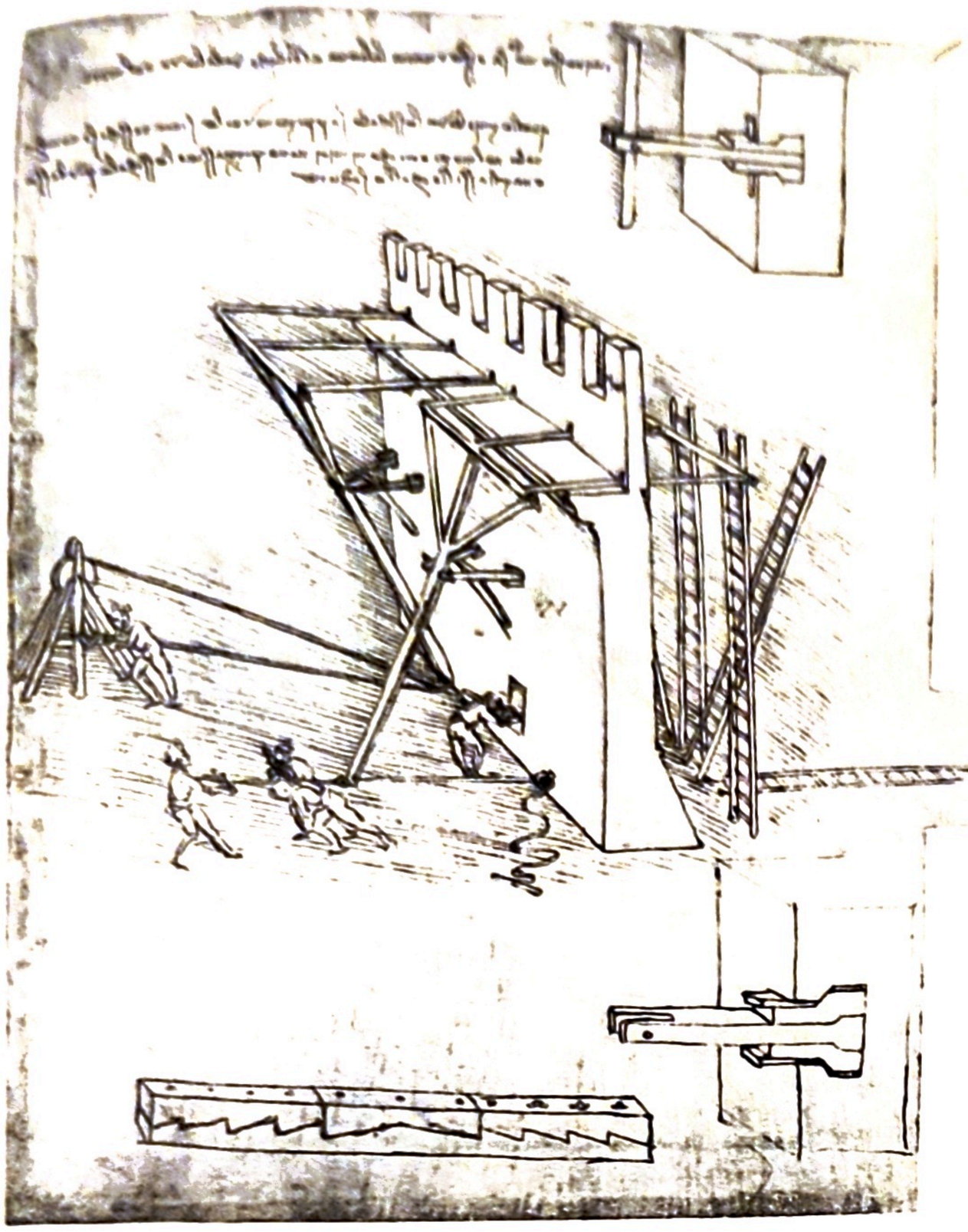
Music was the favourite art at Court. The orchestra, mostly composed of Dutchmen, who dominated the music of the period in Italy, was exceptional. Lodovico appointed the choirmaster of the cathedral, Franchino Gafurio, his first teacher of musical theory. His book on the 'usages of music' was one of the first works to be printed in Milan and exerted a considerable influence for some time after. The portrait head of a musician, shrewd and intelligent, has been recognised as being by Leonardo, and a drawing in Gafurio's book of an organist sitting in front of a towering organ with the names of the notes marked on the pipes has also been attributed to him.

His attitude to music was remarkable. He was well-known as a singer and lute-player which, at the time, indicated that he could also improvise freely. Yet amongst his notes there is no written music apart from the beginning of a canon. He drew many instruments, always with technical ideas as the moving impulse: a drum with mechanical hammer-action regulated by a cog-wheel apparatus, a mechanical hammer for ringing bells, a revolving lyre, the *viola a tasti* which was much used by beggars, also so constructed that it could play 'by itself'.

With his mechanical arts and gift for tasteful productions and decorations, he made himself useful at Lodovico's court. He was valued as a witty conversationalist; he noted in his journals practical jokes, curiosities, puzzles for such and such occasions and witty answers, such as that of the painter who was

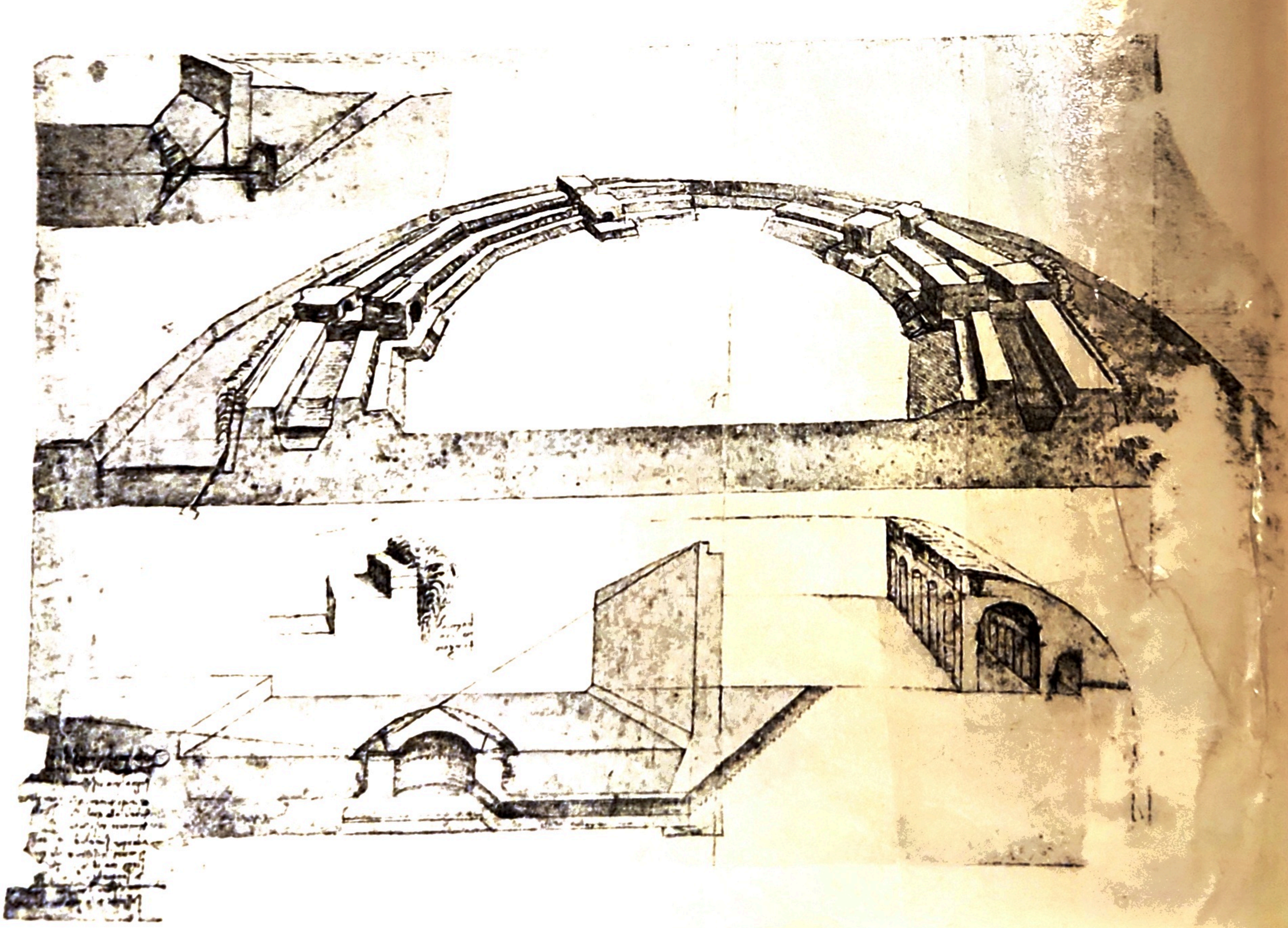
Leonardo's *Madonna Litta*, now in the Hermitage, Leningrad. *Right:* sketch of a head for this painting, from the Louvre

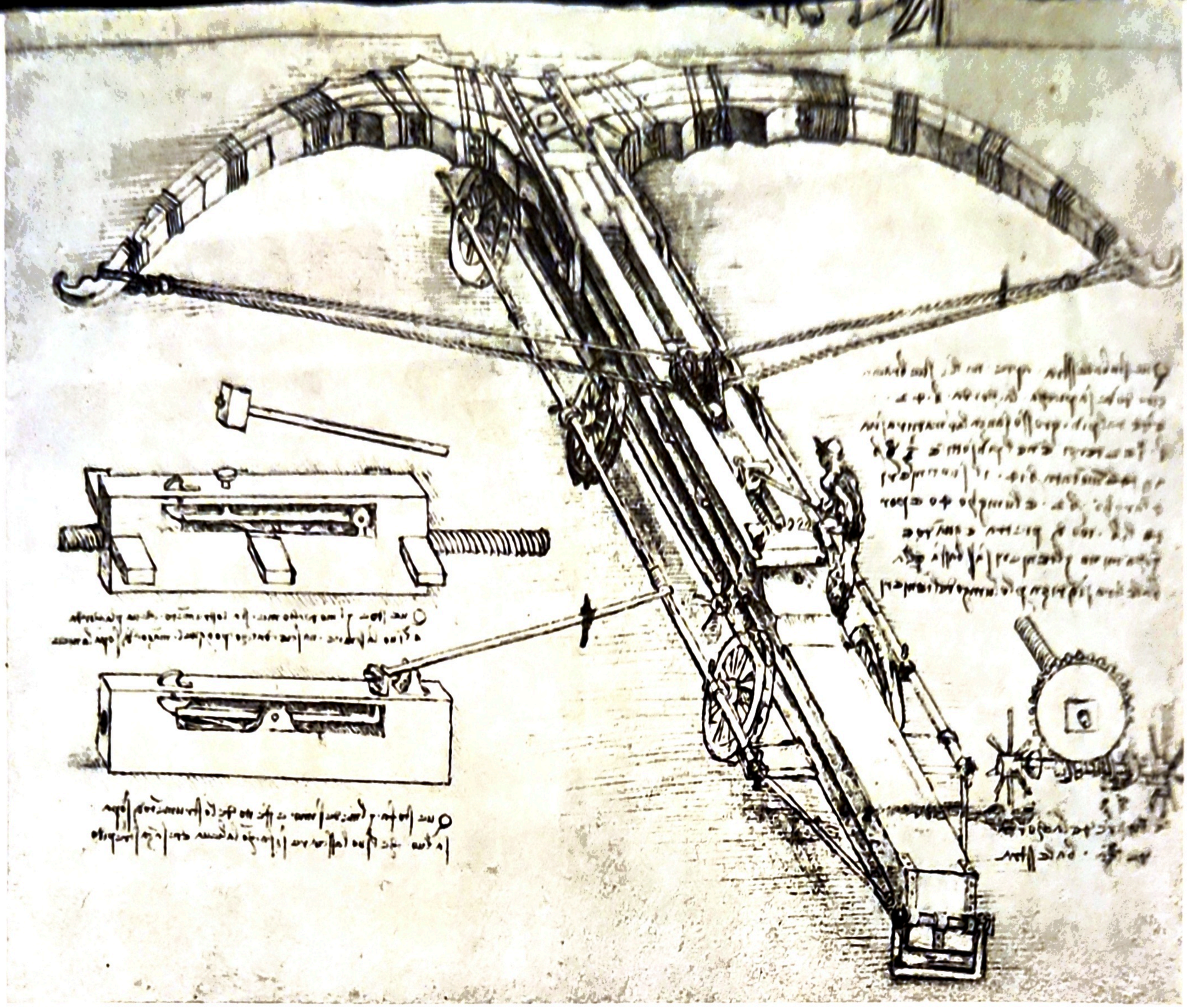




Design for a gigantic crossb
a gun-carriage – a monstrosity
armament that is quite impracti

'Ingeniarius et pictor' – Engineer and
Painter – was the description given of
Leonardo in contemporary document
ideas were far ahead of his times, but
frequently too they were sheer fantas
like the lever apparatus for defence
against storming attacks *(left)*. *Below*
plan for a fortress, such as was only
used in practice several centuries later





Sforza. Lodovico himself had not been the true heir to the principality; his brother had occupied the throne for a few years and on his death he should have been succeeded by his son. The son was, however, deposed and imprisoned by Lodovico who, it was generally believed, eventually poisoned him. Lodovico played for high stakes, and his strength lay in diplomacy rather than artillery. In his heyday he thought seriously of making himself ruler over all Italy. But the last ten years of his life were dark again: he was imprisoned in France until his death. Between the early shadows and the later ones, however, lay a period of great brilliance and political power. He swaggered vociferously and ostentatiously, calling the Pope his chaplain, the Emperor his condottiere, the king of France his courier and swearing to drive the Venetians into the sea. His Court was to excel all others in brilliance and splendour; and its festivities and entertainments were lavish indeed. Only in the fine arts did it lag behind Florence, Venice and Rome. The great project of the cathedral, begun centuries before and not completed until 1813, absorbed all the town's artistic forces and kept them under the spell of the medieval architectural tradition. Milanese art remained provincial and commonplace, although Lodovico, a man of

taste and learning, sought to improve this state of affairs by making new appointments and issuing commissions. A great equestrian statue of Francesco Sforza, the founder of the dynasty, was to spread abroad the renown of the family. The idea of exposing a statue of a secular ruler to public view was still new and indeed rather presumptuous: at that time as a rule only statues of saints and church monuments were publicly shown, although memorial gravestones were allowed. Only condottieri, generals who recruited armies at their own cost, trusting to the fame of their own names, and waged campaigns for various principals, had dared to perpetuate themselves in this way; there had been Gattamelata, the 'spotted cat', portrayed by Donatello, and Colleoni in Venice. Leonardo spent his whole time in Milan working on the Sforza monument; but with the fall of Lodovico il Moro the model was destroyed.

He had not only worked on the horse. It had been some time before he had started to win the confidence of the great ruler; he never won it completely. First he had to look for other works; and so he turned to painting pictures of the Madonna.

There are a number of representations of the Madonna and Child which can be attributed more or less certainly to Leonardo or to his influence. There is the *Madonna Litta*, in the Hermitage, Leningrad, painted in a hard, dry fashion and with an ugly, clashing red and blue in the dress; but the attitude of the head is so delicate and charming that it can belong to nobody but Leonardo, all the more so since one of his drawings shows a head held in an exactly similar position. Another picture, the *Madonna with the Carnation* in which a castle is shown in the background, portrays a woman of the heavy Milanese type. Colleagues and pupils now began to gather round Leonardo and a Milanese school began to form, although it only copied Leonardo's characteristic painting of enigmatic smiles; he never had a large widespread following like Raphael.

During his first years in Milan he collaborated with the de Predis family and lived in their house. They were excellent craftsman: one brother engraved coins and medals, another was a wood-carver, a third a miniature-painter, a fourth, Ambrogio, a portrait painter. Together with Ambrogio, Leonardo entered into negotiations with the Brotherhood of the Immaculate Conception who required a work for the Church of S. Francesco in Milan. The whole proceeding was arranged according to strict tradition: a legal agreement was drawn up, with the required date of completion and exact details of all that the monks required in the picture. The richly carved frame which had cost 710 lire was already available; 800 lire were set apart for the panels which were to fill it. Later the artists petitioned in vain for an increase in the fee which had been stipulated at the beginning.

For the middle section Leonardo created the *Madonna of the Rocks* and, as in all he undertook, far exceeded the original commission and, also as usual,

Lodovico Sfor
Portrait by Boltraf

Leonardo's drawing of a lute made from a horse's skull with ram's horns superposed

was built and used. Lodovico il Moro, the ruler of Milan, was no soldier. He took note of the sketches and plans, pleased to have such a many-sided and talented man at his Court; but nothing was carried out. In fact, it is questionable whether anything was capable of being carried out. Leonardo's far-ranging mind was always interested in the idea, rather than the practical aspect of his inventions; he leapt easily centuries ahead of his time, elaborated themes like a musician, whipped them into variations, took them up anew, ever more grandly, lost himself in artistically exciting depictions of technical problems which no longer had any connection with reality; but he was not interested in how all these brilliant fantasies were to be achieved. The amazing, confusing thing is the contrast between his mixture of loving care and exact calculation as to detail, and his broad carelessness as to the main point. Thus he provided the chariot armed with scythes, of which he had read in classical literature, with an excessively complicated geared, rotating drive. He built the armoured car, also known and used in antiquity, very ingeniously with an observation-tower and wheel-action, a 'motor' which could only be driven by hand; he weighted it down with guns and left it to later ages to find the power necessary to move such a weight. The pleasure of recognising modern ideas and inventions in Leonardo's Renaissance drawings, however, should not blind us to the fact that he was not the first inventor or discoverer in every case. His distinction was that he ranged over every sphere; he was the *uomo universale*, the complete man who was the ideal of the age and who, in fact, could only exist in such an age before the sciences and arts began, with the advent of specialisation, to branch off into strictly divided compartments. This was his greatness and at the same time his doom.

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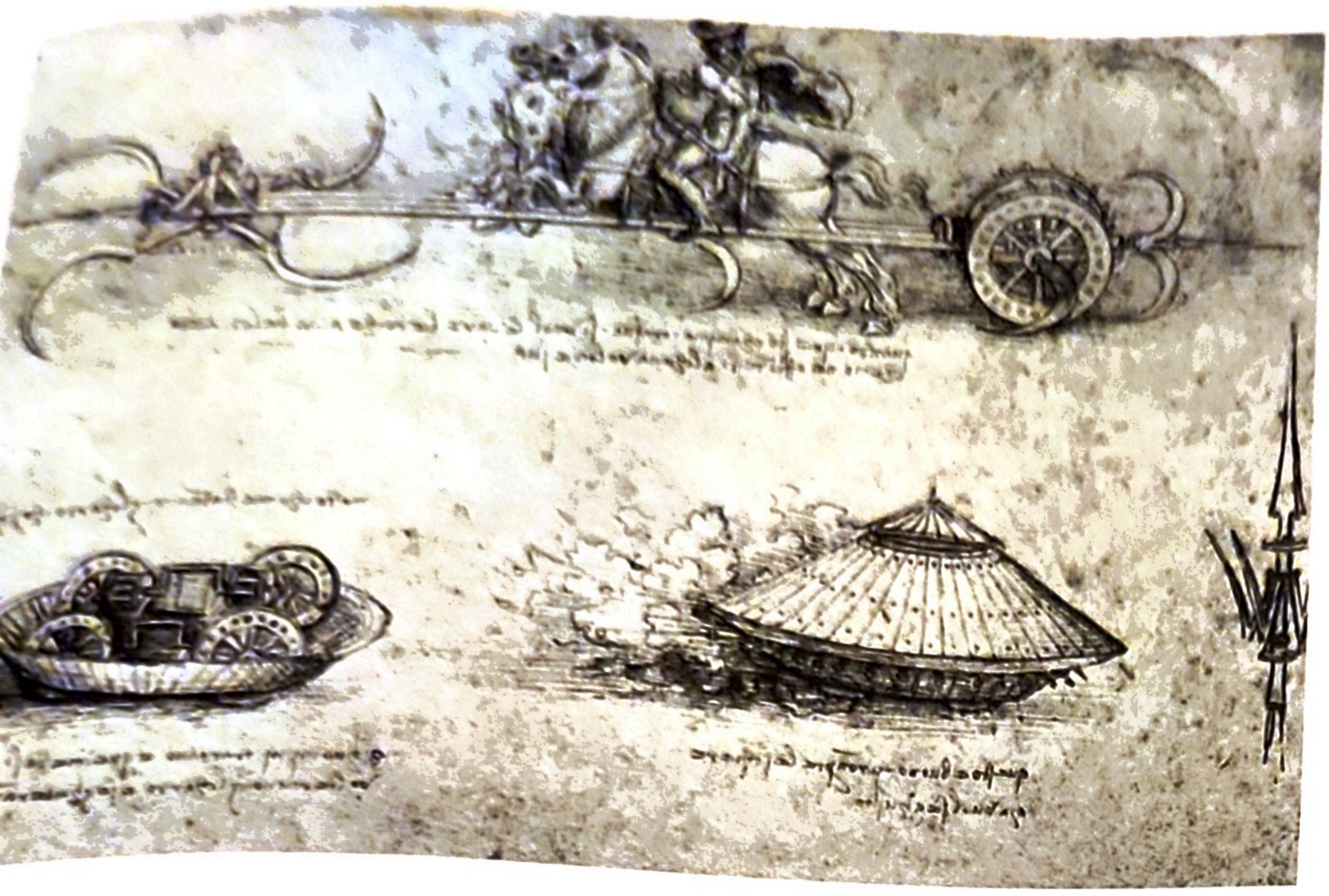


Chariot with scythes and armoured vehicle in a drawing by Leonardo

His attitude to warfare and weapons of destruction is strange and ambiguous. Basically, as all the records agree, he was a most peace-loving man; he could not bear to see trapped animals and bought caged birds in the market in order to set them free. In an age when artists such as Benvenuto Cellini still wore swords and daggers as a customary article of dress, he, with all his great physical strength, went about unarmed, quiet, rather reserved, even with a touch of shyness and mystery, mostly due to his fear of having his ideas and inventions stolen. There is not the slightest evidence that he ever actively took part in any fighting, apart from making his sketch-maps and plans, nor did he have any particularly deep attachement to any of the war lords he served; he designed a monument for the Sforzas in honour of their ancestor Francesco with exactly the same huge self-possession with which he later suggested an adaption of the same monument for the conqueror of the Milan family, Marshal Trivulzio. Paradoxically, he planned many great works of peace — drainage-systems, canals, river-works, town plans, etc. — while at the same time devising the most horrible means of bringing an enemy to book.

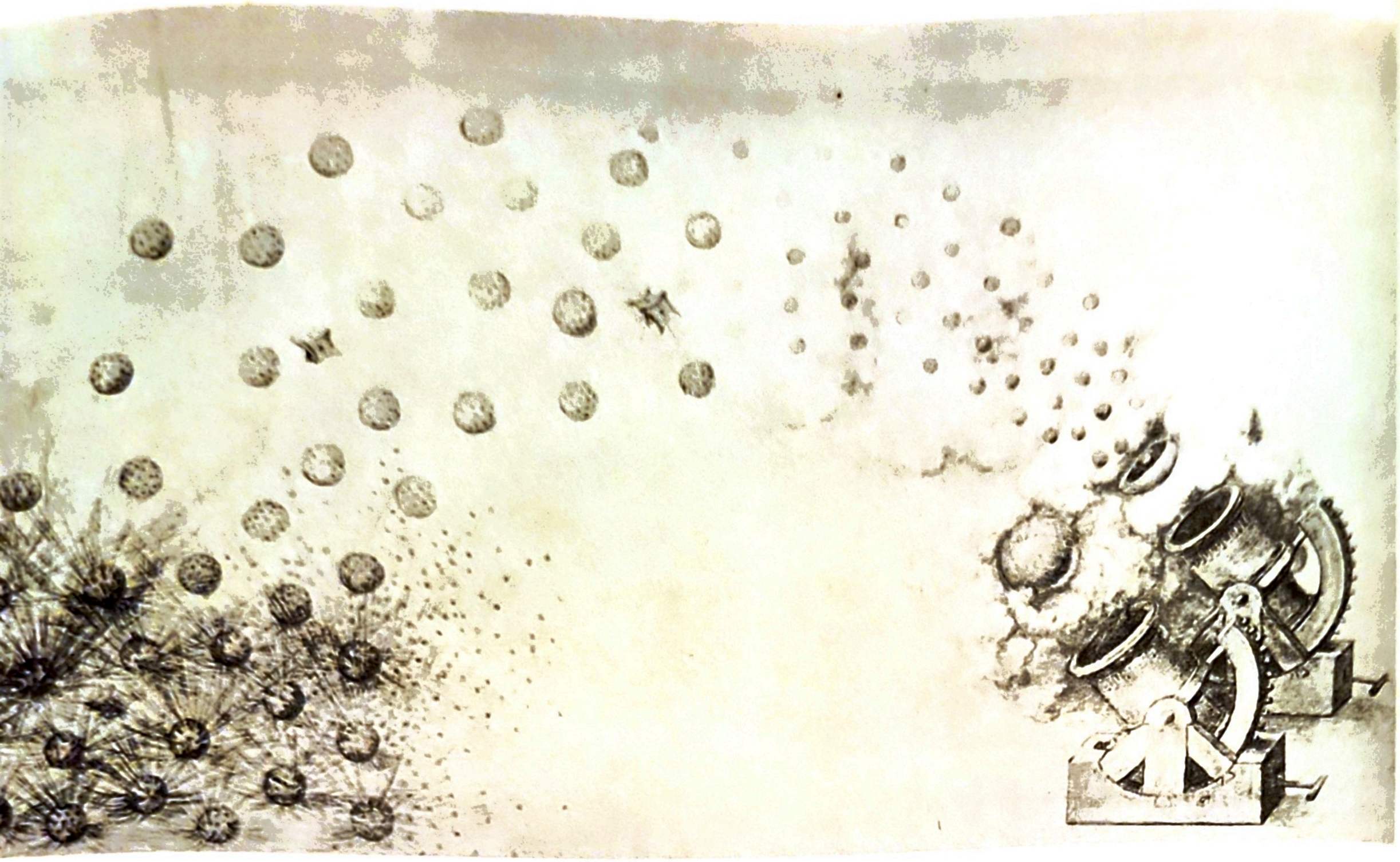
His war-machines, however ingeniously they often appear to be thought out in detail, are often only artistic paraphrases, beautifully drawn allegories of his spiritual and mental condition. If, for instance, he designed a cannon with two mortars, completely exact as to every technical detail, this immediately touches off a chain reaction. The mortars eject a kind of shrapnel, bullets held together by a leather sack. The sack tears immediately after passing the muzzle and

Model of an armoured vehicle designed by Leonardo

allows the bullets to issue in a broadly scattered fashion. But this is not all. The bullets are no ordinary lead bullets: they are to be provided with a detonating powder so that each is independent and can explode individually. A ballistic phantasmagoria — quite apart from the then insoluble problem of causing the explosion at the right moment by some kind of exactly calculated time mechanism: the time-fuse was not invented until the nineteenth century.

Nevertheless the science of ballistics was not completely undeveloped in Leonardo's period. Milan's cannon foundries were famous. In one of his large drawings he represented a huge crane on which hung a cannon barrel capable of being raised into position by winding and levering. Here, too, the dimensions of the barrel greatly exceed anything that was possible at that time. All the details and accessories are acutely observed; the workers manœuvring the huge cannon form a splendid group-study in which the perspective and fore-shortening are brilliantly achieved.

Leonardo tackled siege-methods from every point of view and in all their variations: side by side one can find very ancient and breath-takingly 'modern' ideas. For instance, he shows a crenellated wall which the enemy is storming with scaling-ladders; as defence he depicts a lever mechanism which penetrates through the wall from inside and overturns the scaling-ladders. He sketches the supports which are to be plugged into the wall and assist the lever mechanism. This whole idea smacks of the Middle Ages. But since then the artillery had become more powerful and so he draws a completely flat, polygonal bastion,



Mortars with self-igniting bombs

Device for transporting a giant cannon

such as was to be used in the eighteenth century. Dürer had also thought of this; all these ideas were 'in the air', filled, as was the age, with thoughts of warfare and gunpowder. Before and during Leonardo's time, hundreds of artillery-men rocketeers, engineers, plan-makers and practical arms-manufacturers were at work; even now historians of technology are only beginning to understand the full significance of the many manuscripts and drawings of the day, most of which were formulated in extreme secrecy and so are not easy to interpret at the present time. The printed works then beginning to appear, the books of Vitruvius and Vegetius, for instance, were also illustrated and enriched with an abundance of new and fantastic ideas. Leonardo's drawings are only distinguished from all the others by their artistic perfection and modernity.

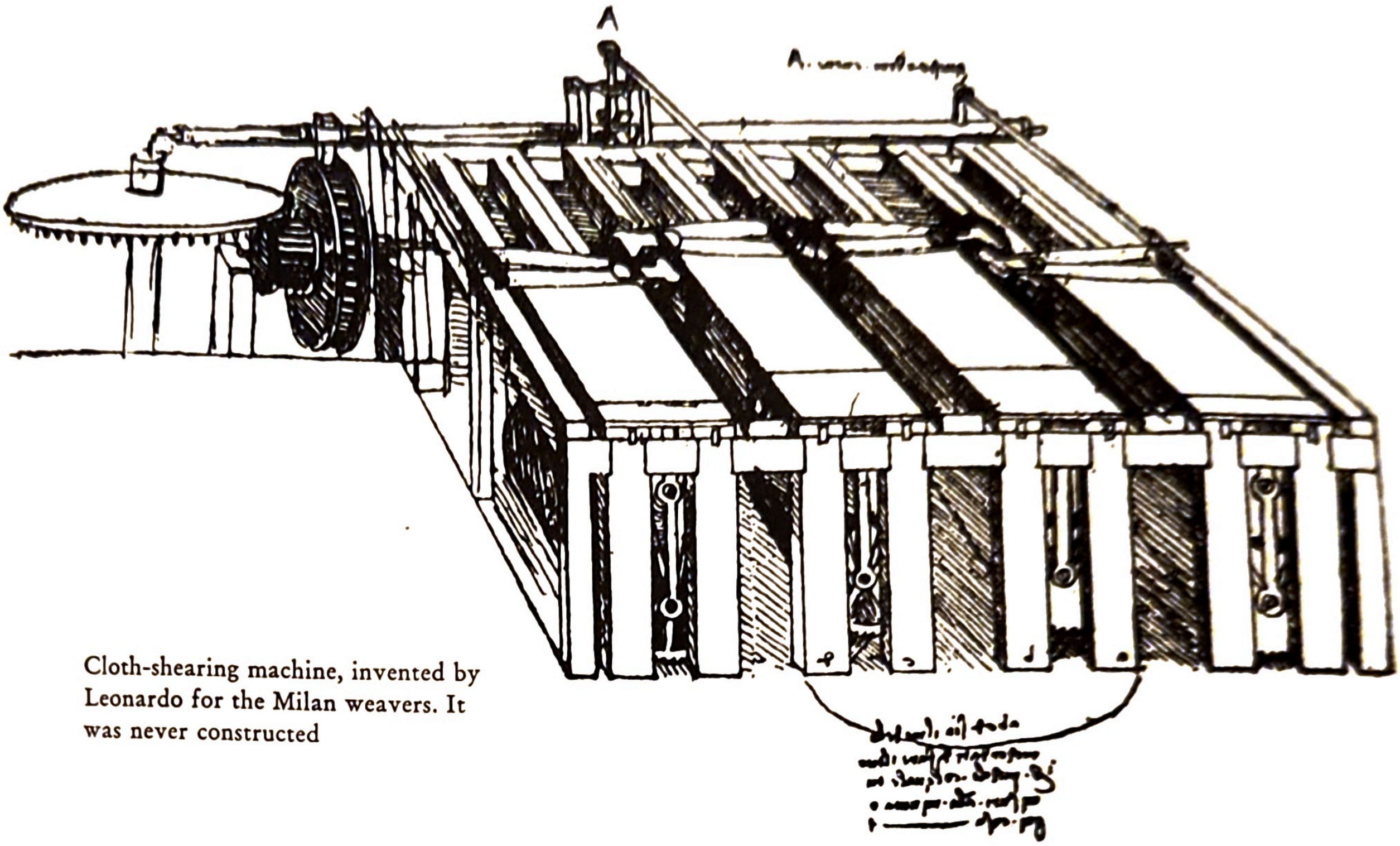
Lodovico il Moro, ruler of the principality of Milan, to whom Leonardo submitted his plans, was a man of the new era, although no great general. Far from being a Nietzschean 'blonde beast', he got his name 'il Moro' ('the Moor') from his dark skin. Dark, too, were the machinations through which he came to power and the origin of his family; he descended from a shoemaker and the family had only attained its position as ruler of rich Milan in the previous generation, through the good offices of the Condottiere Francesco

Design for an equestrian statue.
After the model of the 'Great Horse' had been
destroyed by the French when
they took Milan, Leonardo
redesigned it as a monument for
the victorious marshal Trivulzio

intimate personal use of solid silver. The 'colossus', as the model for the statue was called, excited the admiration of the princely guests as much as the living crocodile that was also shown. The Court poets celebrated both the great event and the enormous monument to the power of the Sforzas; one of them wrote: 'I am quite convinced, and I know I am not wrong: neither Greece nor Rome saw anything greater.'

Now it only remained to cast the 'Great Horse' and set the statue of the duke on its back. It is characteristic of Leonardo that in the multitude of plans the figure of the duke fell into the background and remained shadowy and indistinct. Lodovico had reached the peak of his intrigues. All Italy was at his feet. He summoned the French and, a year after the marriage, Charles VIII crossed the Alps. He attacked Naples, sacked Rome and contrived that the people of Florence should drive the Medici out of their own city. The Duke boasted to the envoys of the great: 'See I hold peace in one hand and war in the other.' In the event, it was war which won the day. The French turned against Lodovico and Charles used the claims given him by a marriage between one of the French royal house and a Visconti to enlist the aid of the latter family, which had ruled in Milan before the rise of the Sforzas. Once again Lodovico called on a number of allies — the Venetians, whom he had once sought to drive into the sea, the sea, the Emperor, England. The attack failed, the league collapsed and the French, after a temporary withdrawal to Savoy, soon returned, and were later victorious. Nearly ninety tons of bronze had been laboriously collected for the statue. Leonardo wrote to the duke: 'For thirty-six months I have had six mouths to feed and all I have received is fifty ducats.' Resignedly, he added: 'Of the horse I say nothing. I know that the moment is inapposite.' And elsewhere: 'I know that your thoughts, Your Highness, are occupied by other things.'

The bronze for the Sforza monument found its way into the cannon foundries, but the cannons were not completed either. The Duke made a last desperate appeal to the Milanese; his Swiss mercenaries had already deserted him. Nobody took his part. The French entered Milan unopposed; Lodovico fled but was betrayed and delivered over to the enemy. The leader of the French troops was Marshal Trivulzio, a Milanese whom in the past Lodovico had hanged in effigy. Later Leonardo designed for him a new version of his



Cloth-shearing machine, invented by Leonardo for the Milan weavers. It was never constructed

single sphere of engineering on which Leonardo had not sounded him. He presented ideas for canals, sewage works — and in the latter project Lodovico took a (modest) interest; on the duke's model farm he built a graduated slope down which a mill-stream was to run. There was an even more humble achievement — in the palace at Milan he built a small Turkish bath for the Duchess. It appears that he was ready to take on any task, however trivial.

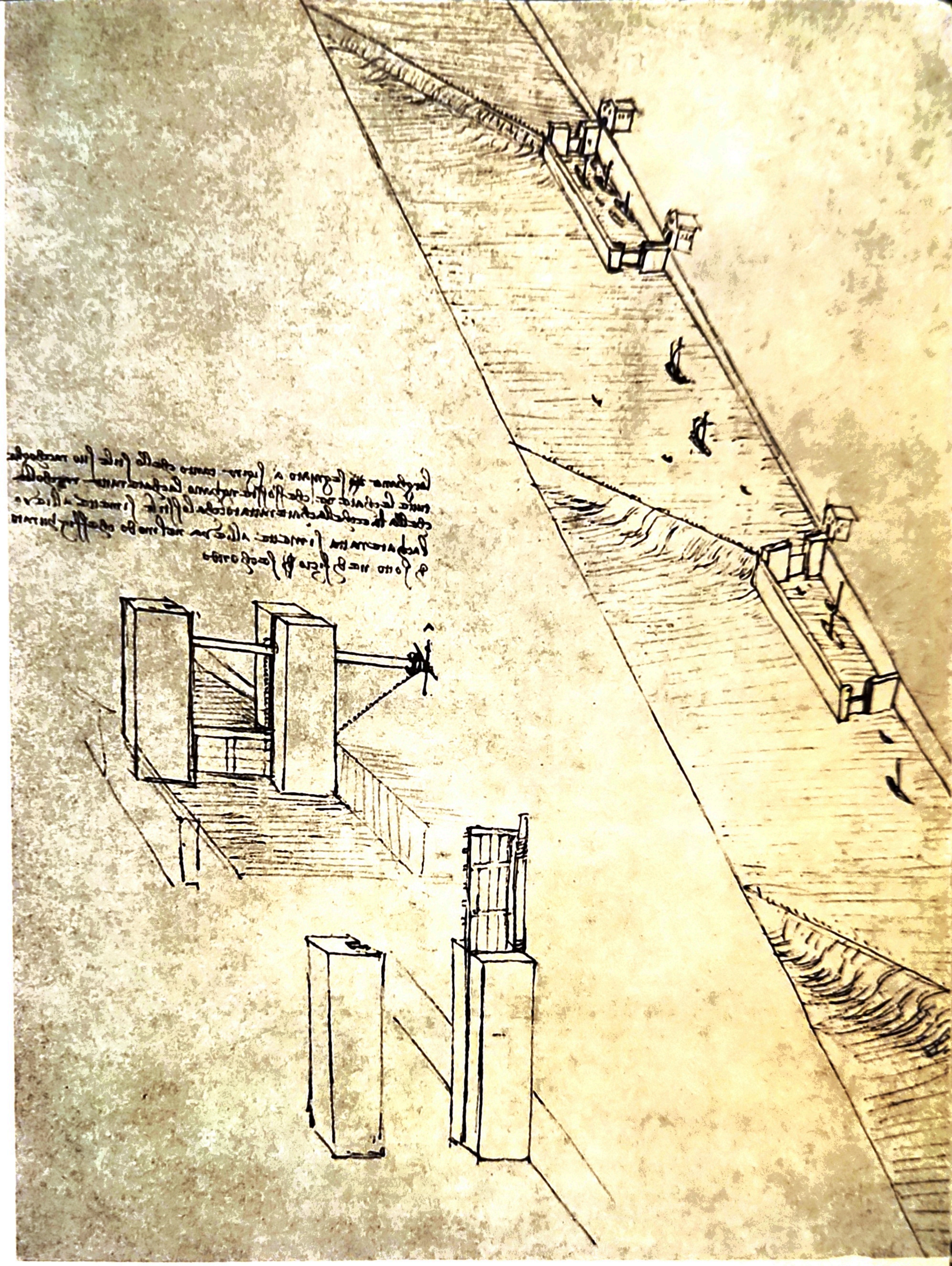
It was as a result of the most ephemeral and insignificant of these commissions, those for the Court festivities, that he came to work on the 'Great Horse', the work which for the first time made Leonardo's name known throughout Italy. After all the proofs he had received of his Florentine artist's skill, Lodovico was content with his present revenue, greater than England's, of Sforza not only in scenery and frivolous decorations but in a full-scale monument 'to be exhibited in a public place and cast in bronze so that it would endure for all time'. It was to surpass everything which had gone before, the monuments of antiquity, the statue Leopold had seen in Pavia, the famous Byzantine horses in front of St Mark's in Venice, the equestrian statue of Gattamelata in Padua and the statue of Colleoni which Leonardo had seen being made in the workshop of his teacher Verrocchio. The monumental size of the project appealed equally to Lodovico's ambition and to Leonardo's taste for colossal things and things which had never been done before. In addition there were highly complicated technical problems to be solved in

connection with the casting, for which there was no past experience to draw on, since they were using ten times more metal than had previously been used on a single work.

A workshop was set up for Leonardo in the Corte Vecchio, in the older part of the palace in Milan. He received forceful instructions to start work on the statue in all earnestness. A few months after the performance of the play *Paradiso* he noted: 'Began on the horse again.' And, incorrigible as ever, he set about improving on all current conventions. He was not content to study examples already in existence which mostly depicted the horse in a standing position or, at the most, in a measured tread. He drew horses in energetic postures, turning, lying on the ground, leaping, or pawing the air over an enemy in a savage attitude. All this gave him ideas for cavalry battles which he later embodied in his *Battle of Anghiari*. He visited the stables of the nobility and made notes on the characteristics of the various kinds of horses: 'Proportions of the Sicilian horse with the hind leg lifted and stretched out, seen from behind', or: 'Messer Mariolo's Florentine horse, a strong animal with a fine neck and particularly handsome head'. Most of his subjects were strong, powerful horses, bred to carry a heavily armed man; there had been as yet no attempt at breeding slim, elegant horses suitable for gentlemen riders. He studied the characteristics of horses' faces and made studies of horses in wild excitement, with the nostrils distended and teeth bared. He went further

Sketch for the control of a ri
by means of oblique weirs a
sluices in which the ships that are to be propel
upstream are indica

Sketch of a villa. The plan shows the classical style of the Italian villa, which Palladio in particular developed, causing it to be adopted beyond the confines of Italy, above all in England, and which played an important role in European architecture up to the 19th century



Horse stu
Bottom right: St G
and the Dra

Sketch for the casting of the
'Great Horse'. Leonardo was intent on
solving the technical problems of casting.
But Lodovico sent all the metal intended
for the monument to his brother-in-law,
the Duke of Ferrara, in 1494,
to turn into armaments

and investigated the horse's bone-structure and muscular system, its anatomy in general. In fact he planned a treatise on the anatomy of the horse. With the most intricate and minute calculations he divided the total length of the animal into nine hundred parts and tried to devise an enormously complicated canon of rules.

In his original plans for the statue he had envisaged a figure on a rearing horse riding down an opponent; and later when he took up the theme again in planning an equally magnificent statue for the conqueror of the Sforzas, Marshal Trivulzio, he again considered this design. But it was technically impossible with the means then available and so, for the Sforza monument, he turned back to the simpler form of a pacing horse. Even for this many technical problems had to be solved. He planned to cast it in one piece by means of four furnaces from which the metal would flow simultaneously. He also designed a framework for the model which he later constructed with the aid of a number of helpers, including in the sketch detailed drawings of the iron supports which were to lend stability to the legs. From time to time Lodovico lost patience and confidence in his continually hesitant sculptor and considered enlisting new talents.

At last the model was completed. Lodovico had it ceremoniously displayed in front of the palace on the occasion of the marriage of his niece to Emperor Maximilian who was much in debt and whom he lured into a secret treaty by means of a dowry of 400,000 ducats. The princess's trousseau remained the talk of all Europe for months; her jewellery alone was estimated to cost 40,000 ducats, the toilet articles were of gold and ivory and the utensils for

Modern shells?
Models of missiles designed by Leonardo,
which actually meet ballistic requirements

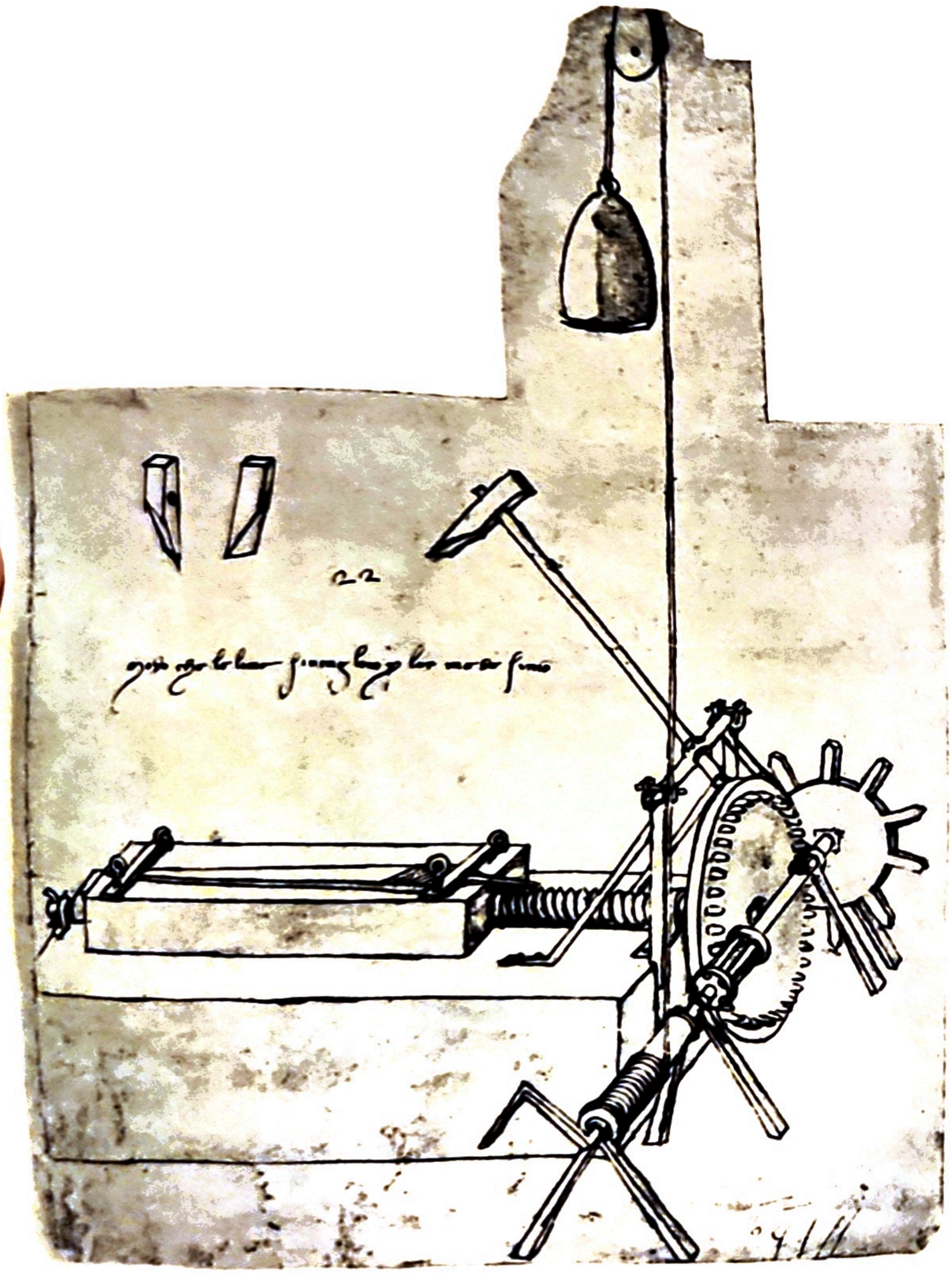
momentum; this was raised by means of a handle and drove a cog-wheel which at each revolution released a hammer. At the same time a jack-screw automatically moved the block with the file. The oblique position of the chisel at the end of the hammer apparatus was particularly noted and sketched at the side of the main sketch.

He needed lever-apparatus to move large weights. Again and again he attacked the problem of increasing the power of the human arm. He worked on screws, propellors and cogwheels and drew powerful cranes to be used in erecting pillars. For this, of course, ropes and wires were necessary. Rope-making was an ancient craft; he constructed a rope-making machine which could replace a whole guild of craftsmen.

He had assistants and workmen. There are notes about them, dating from his Milan days — he always made notes on his present work mingled with his plans for the future, a habit no doubt inherited from his precise lawyer father. In one such note he says: 'On the first of November we settled our accounts. Giulio had still to be paid for four months, Master Tomaso for nine. Master Tomaso has also produced six candlesticks: ten days; Giulio various springs: fifteen days. He worked on his own account until 27th May and, for me, on a lever-winder, from 18th July till 17th August, spending half a day of this period working for a lady; then he again worked on two locks for me until

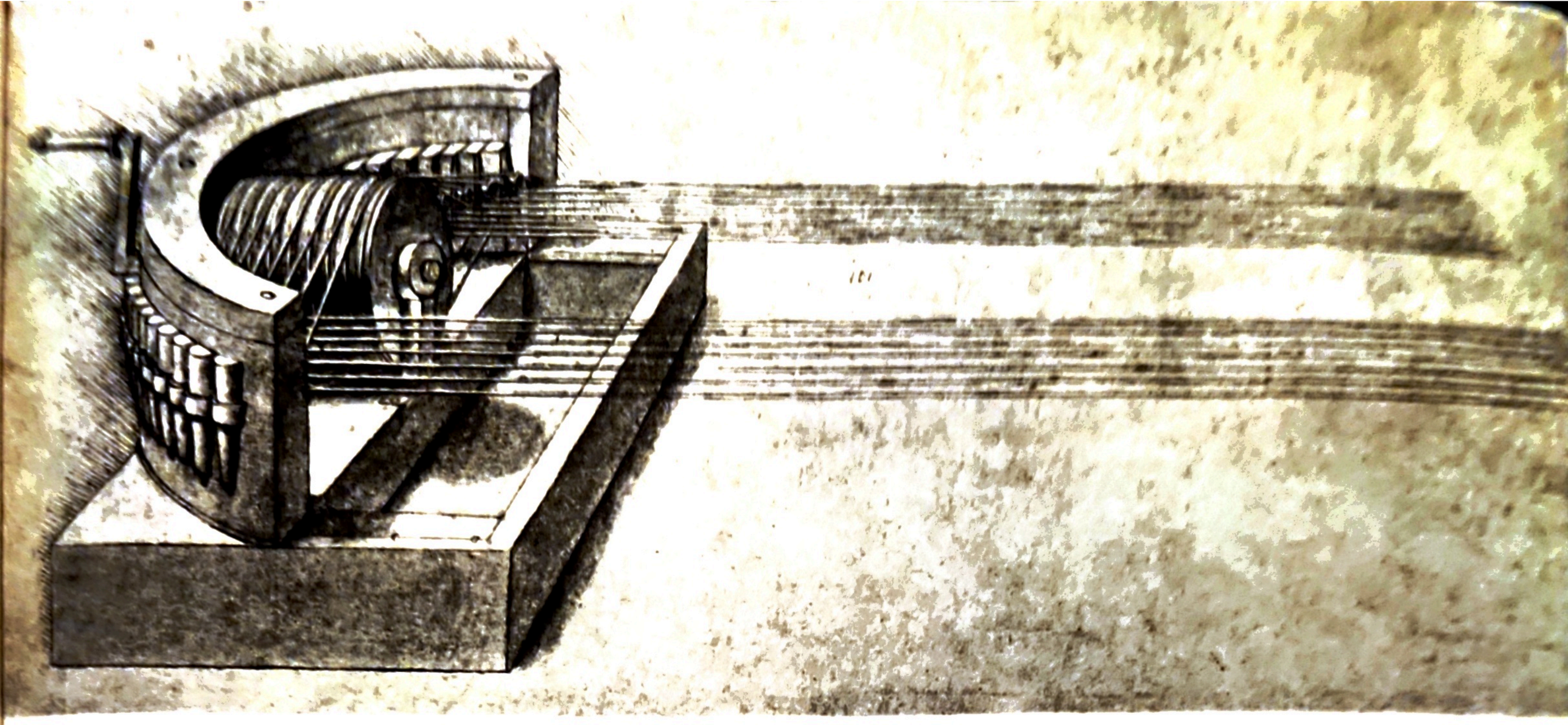
20th August.' Giulio was a German mechanic: later, when he was in Rome, Leonardo employed yet another German workman. He tried to keep his most important ideas a secret from all his employees; on one occasion he complained bitterly that people were attempting to steal his inventions. The fact that his assistants also worked for other employers suggests that he engaged them only for individual tasks and work on component parts. All this secrecy soon gained him the reputation of being a magician.

In fact, however, he despised all magic, sorcery and astrology, although these black arts engaged the attention of most of the other great men of the age. He wrote scornfully of 'alchemists who try to make gold and silver,



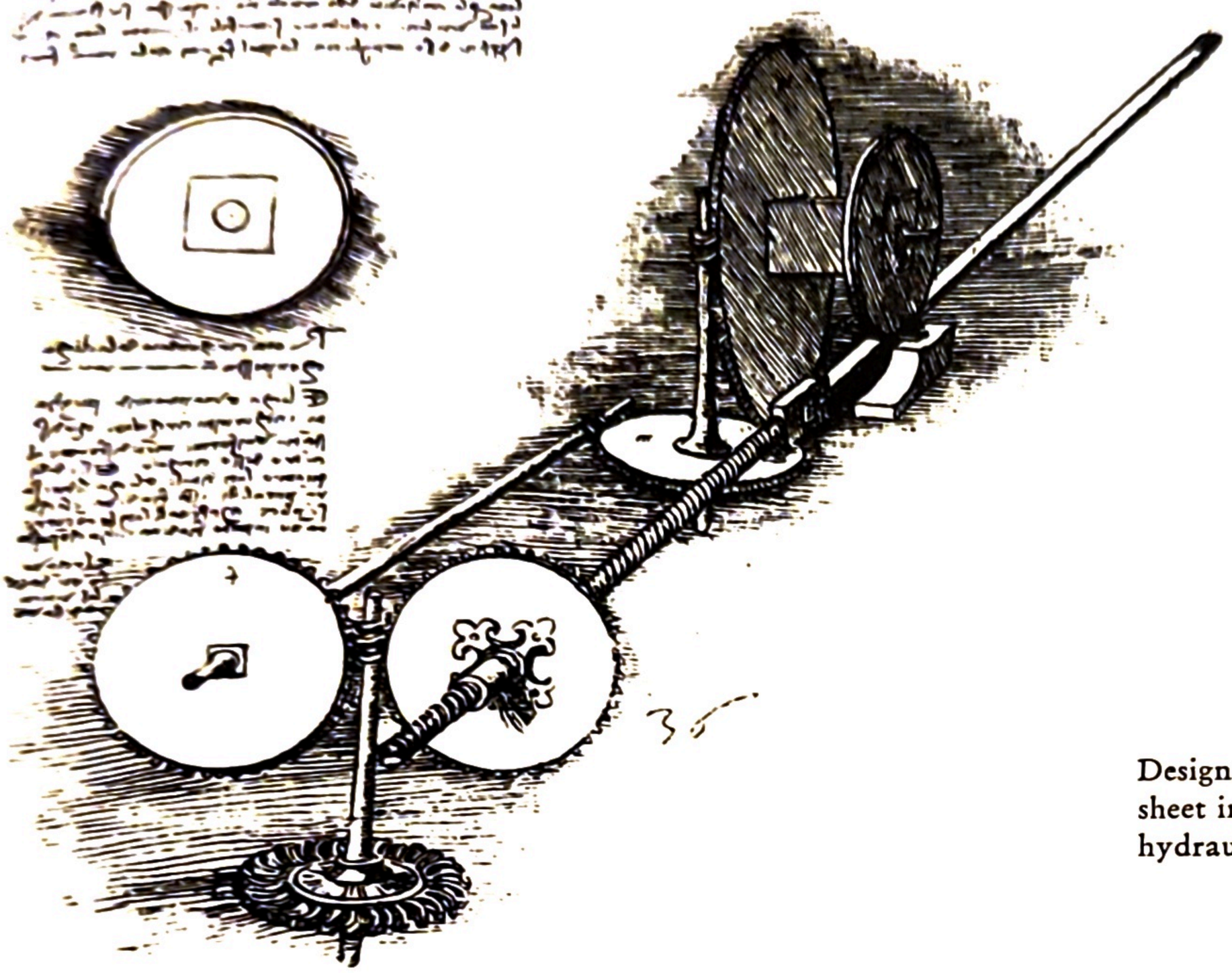
Right: design for a rope-maki
machine with hand-wind

Sketch of a file-cutting machine. The forward movement of the piece of metal and the impact of the hammer are 'synchronised'. The oblique positioning of the chisels making the notches is particularly noted *(top left)*



engineers who attempt to make still water move by itself, by means of constant rotation *(perpetuum mobile)* and all such fools, necromancers and wizards.'

His ambition was for knowledge: 'Knowledge is the general, practice the troops.' And to him knowledge meant mathematics as the motive power, and experimentation as 'the means of interpreting ingenious nature to the human race'. Thus he wrote: 'Experiments never err; it is only the interpretation of them which errs, when a man stubbornly insists on a different result from the one he has seen with his own eyes . . . Men are unjust in complaining of experiments and reproaching them for being deceptive. Let experiments alone and lay your complaints at the door of your own ignorance . . . which leads you to attempt things beyond your powers.' He is proud, even arrogant, in his remarks about the scholars who base their opinions on the authority of books, and then he says humbly: 'O student of nature, do not pride yourself on knowing things which Nature, in her wisdom, has created; but be thankful to know the function and purpose of things which your own brain has conceived.' His remarks often take the form of a dialogue with an opponent who contradicts him or with enemies or adversaries, while sometimes they read as a monologue. Then suddenly one finds a moving expression of his modesty: 'Since I see that I can produce no material of great usefulness and acceptability, because those who were born before me have already dealt with everything useful and agreeable, I shall imitate the poor man who arrives last at the market. Since there is nothing more of value for him to take he gathers together all the things which other people had looked at but not taken or had rejected as of little worth. I shall load these trivial and despised wares, the leavings of many earlier clients, on to my feeble beast of burden. I shall go with my stock not

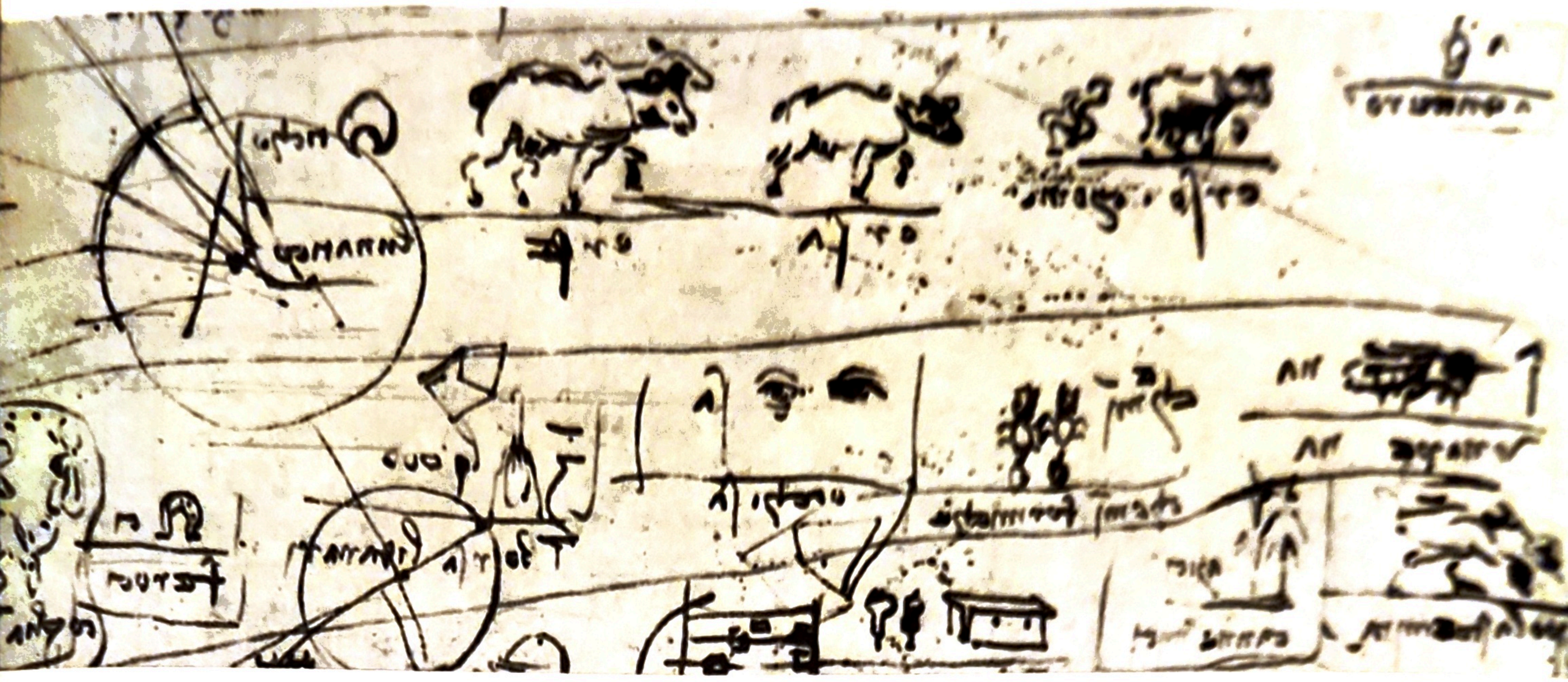


Design for a rolling-mill to produce sheet iron for cannon barrels. It is hydraulically powered

to the great cities but to the poor villages where I shall display it and accept whatever price it fetches.'

It is not easy to see what price he received in the long years before he made an impression on Lodovico with his designs for the equestrian statue. He was never poor; he always had servants, assistants and workmen, and Vasari mentions that he possessed a riding-horse, a considerable luxury in those days. He even sent home money from Milan to Florence, where he thought it safer, and deposited it with the monastery of Santa Maria Novella.

Again and again he tried to arouse Lodovico's interest in functional problems. He suggested that a rolling-mill should manufacture iron bars for cannon-production; Lodovico trusted to diplomacy to overcome the enemy. He invented a cloth-shearing machine for the duchy's most important, largest-earning industry, a machine which would double, even quadruple, its output; Lodovico was content with his present revenue, greater than England's, of 600,000 ducats. He drew designs of villas in a strictly classical style; instead of building villas, the duke extended the castle, which had to act as a fortification against the treacherous people of the city. Nor was he interested in town-plans which took his subjects too far out of the reach of his cannons. He was not to be moved by designs for needle-grinding machines, stills, windmills with revolving roofs or printing presses (the first printers, mostly still Germans, had set up workshops in Milan); in the end there was hardly a



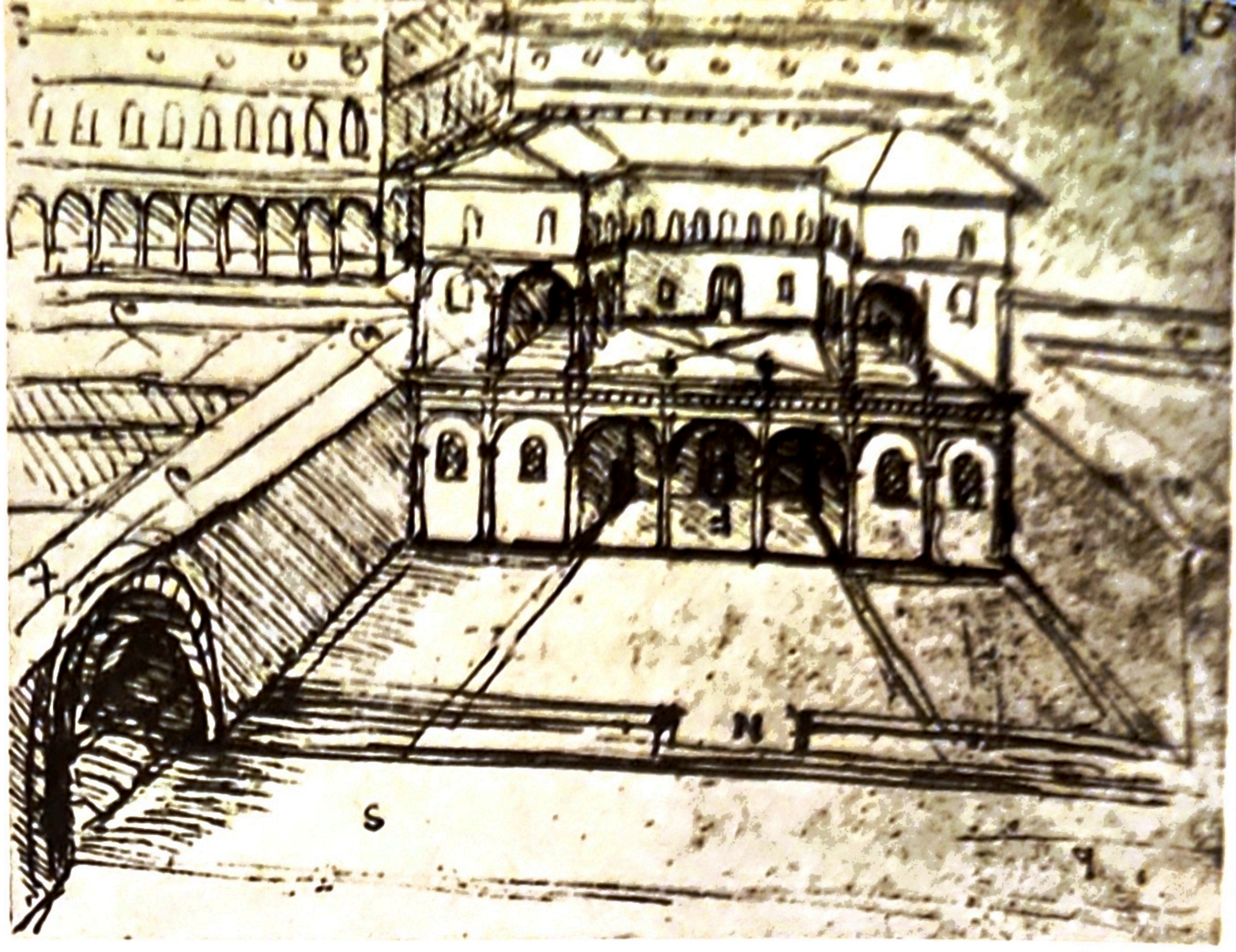
distributes a whole series of connected ideas through several pages. Often he merely notes words, expressions or allusions out of books; he had read a great deal, knew a little Latin and possibly also a few words of Greek. Much of his learning was, admittedly, gained from anthologies and collections of extracts; he never studied a whole work by a classical writer any more than he wrote a complete work of his own. Even his famous *Treatise on Painting (Trattato della Pittura)* which was the only written work of his known to exist until the discovery of his private notebooks, was only put together after his death from fragments, a *Polemic on the Value of Painting in Comparison with the Other Arts* and various drawings on the same theme; the same is true of his *Book on the Movement of Water*. Even today research is still continuing on the huge mass of his writings, more than seven thousand pages of it; the process is made even more difficult by the fact that posterity has added to the disorder, in particular in the huge *Codex Atlanticus*. A century after Leonardo's death Michelangelo's pupil Pompeo Leoni tidied it up, mounted the individual pages and provided them with little windows on the back so that both sides of the page were visible. Even the commonly used name 'codex' is a misnomer. His *Codex on the Flight of Birds* is merely a small, pocket-size notebook which he was accustomed to wear at his belt in order to note down what he saw and thought during his walks. Leonardo was a wanderer; even his thoughts wander. His much-discussed 'method' was merely that of the intelligent questioner. He questioned not only others but himself, and many of his questions were not answered until centuries later, while some still remain unanswered at the present day.

His writings

LIONARDO DA VINCI

VITA DI LIONARDO DA VINCI
PITTORE, ET SCVLTORE
FIORENTINO.

The portrait of Leonardo in Giorgio Vasari's biography (1568)



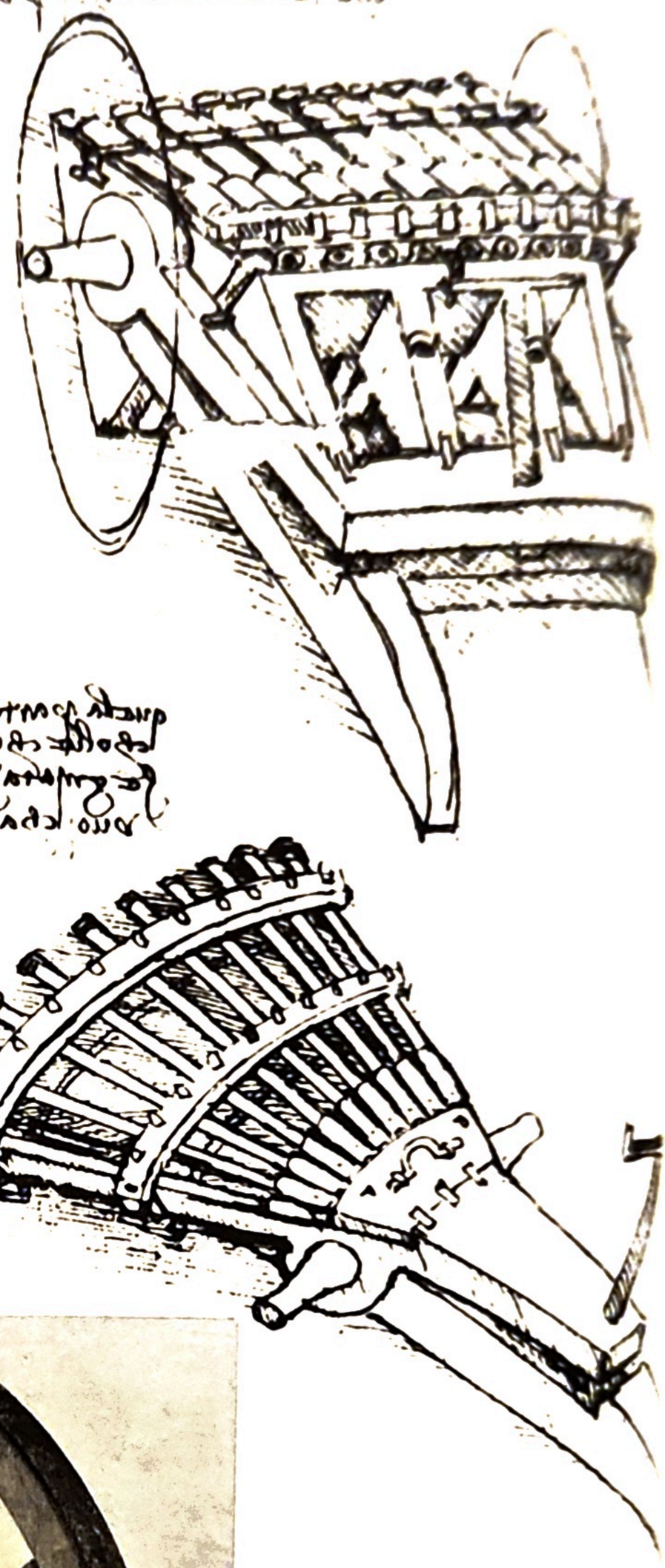
'Modern traffic system' in a sketch of Leonardo's. It actually shows elevated roadways and multiple traffic 'lanes'

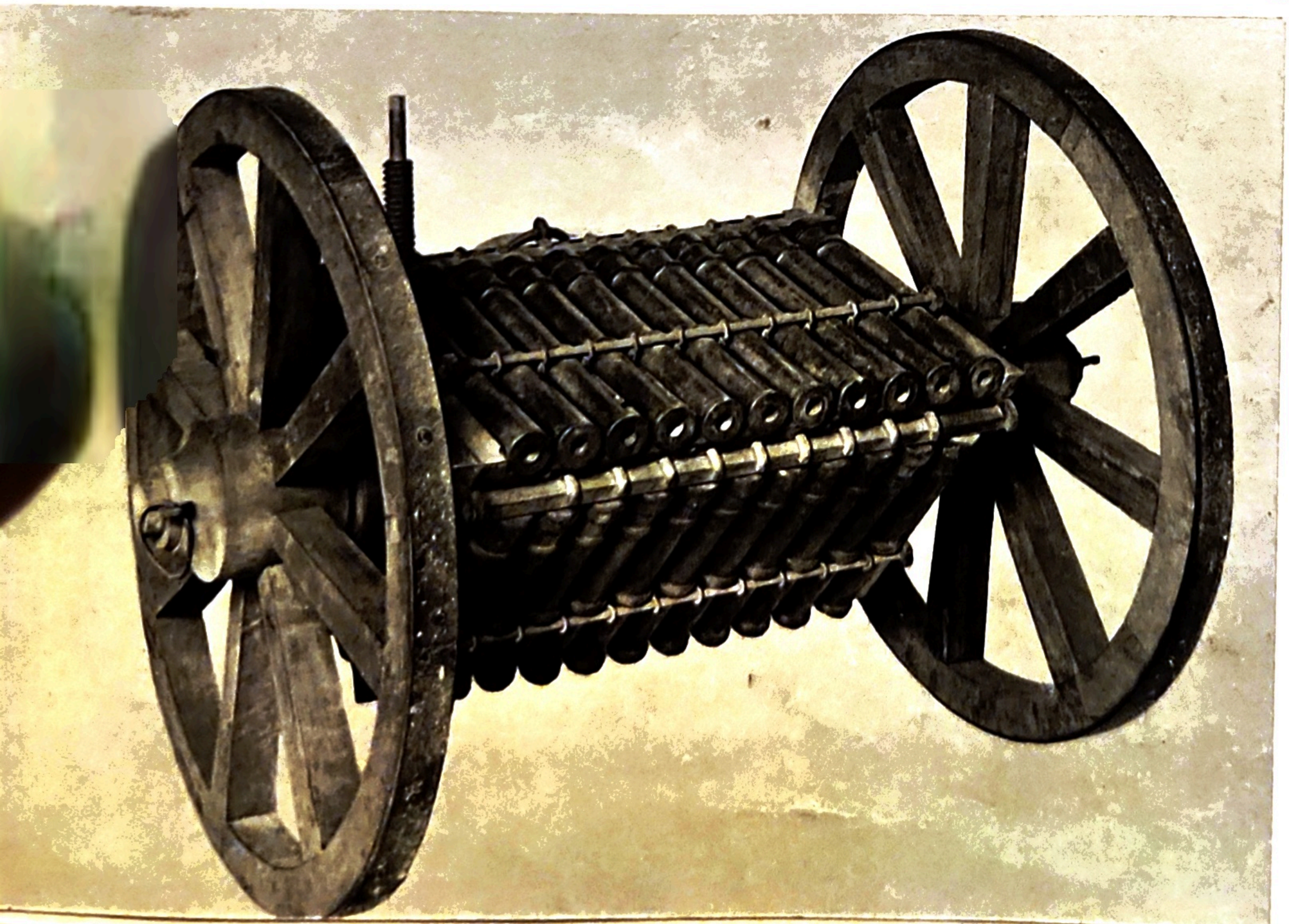
For instance, in his sketch-plans of towns he tackled the problem of two-level streets — a problem which is assuredly far more urgent now, with modern traffic difficulties — suggesting that the higher level be used by the nobility and the lower by the common people and commercial vehicles. This plan is interesting for its demonstration of the aristocratic outlook of a man who was, after all, the son of a peasant-woman.

Double and multiple objects were his delight. He used the idea in his war-engines. Not content with designing new cannons, he devised a 'steam-cannon' which, with a mysterious allusion to a writing possibly by Archimedes, he christened the 'Architronito', the 'Arch-Thunderer'. Over an oblong box containing coal is a water tank which can be heated and sends steam through a screw, thus ejecting the cannon ball, 'so that it seems miraculous and it is amazing to see the swiftness and hear the noise'. He went so far as to design wheels for this apparatus and provide it with gun-sights; but it was never actually manufactured.

His favourite cannons resembled organs with five, ten or even a dozen pipes, of a kind which were in fact produced and used in the following centuries and found a practical application in the 'mitrailleuse' or 'Stalin organ'. He took an equal interest in bullets, studying air-resistance and devising shells of a precise, aerodynamic elegance — articles with which we are uncomfortably familiar from the wars of the past half-century. Each idea led him on to a new one: the metalwork for all these new devices demanded new tools. Making files by hand was a laborious and often unsatisfactory process. So he constructed a file-cutting machine, a 'method whereby the files notch themselves'. It consisted of a heavy weight hanging down from the roof and providing the

Multi-barrelled guns – artillery inventions of Leonardo's which anticipate modern rapid-fire and rocket guns. In the 15th century such weapons were Utopian. Even the first 'mitrailleuses' of the 19th century were basically no advance on Leonardo's idea, which has since been produced in model form (*bottom*)





Sheet containing caricatures.
Leonardo was just as interested
in ugliness as in beauty

equestrian statue for the Sforzas. After Milan was captured, the model for the 'Great Horse' was used as a practice target by Trivulzio's Gascon archers and totally destroyed.

Lodovico's triumphant reign had lasted five years. Leonardo had left him just in time, a few months before his final collapse. He noted down the fate of his Milanese acquaintances. 'The castellan has been taken prisoner and Visconti taken away, after which his son died. Gian della Rosa has been robbed of all his money.' And at the end, coldly objective: 'The Duke had lost his land, his possessions and his freedom and he never completed a single one of his projects.'

The 'Great Horse' was, of course, one of these incompleted projects. Nevertheless it had spread Leonardo's fame throughout Italy. His ideas were adapted or copied in many drawings and equestrian statuettes by other artists; echoes of it have even been discerned in the horse in Dürer's engraving of a knight with Death and the Devil.

It is easy to understand why Leonardo was often bitter in the following years. At the best of times he was always a prey to forebodings and premonitions of great catastrophes. With acute, almost malicious, penetration he compared age and youth: age — decrepit, shrivelled; youth — in full bloom, with the features of a Greek hero. He drew a picture, in the vein of the medieval 'farces', of a rich old crone buying herself a handsome young man. And he filled many pages with grotesques of one kind or another. In the centuries to follow these 'caricatures' were almost the only productions of his that were known; they were copied, engraved and printed in a series entitled *Characters* along with his *Treatise on Painting*. In fact they are types, characteristic forms of ugliness, rather than caricatures of particular people. Leonardo was no less interested in ugliness than in ideal beauty. He went on quests for strange, deformed figures, noting down their addresses: 'Giovannina, with a fantastic face, can be found in the Santa Catarina Hospital.' Vasari wrote of him: 'He was so spellbound by curious countenances that he would follow anybody who excited his interest for a whole day, gaining such a clear mental picture of the man that when he reached home he could draw it as exactly as if the model had been present.'

'*The Last Supper*'

In this period of war, unrest, intrigues, trouble and poverty, Leonardo created his *Last Supper*, the greatest, most tranquil and most unearthly of all

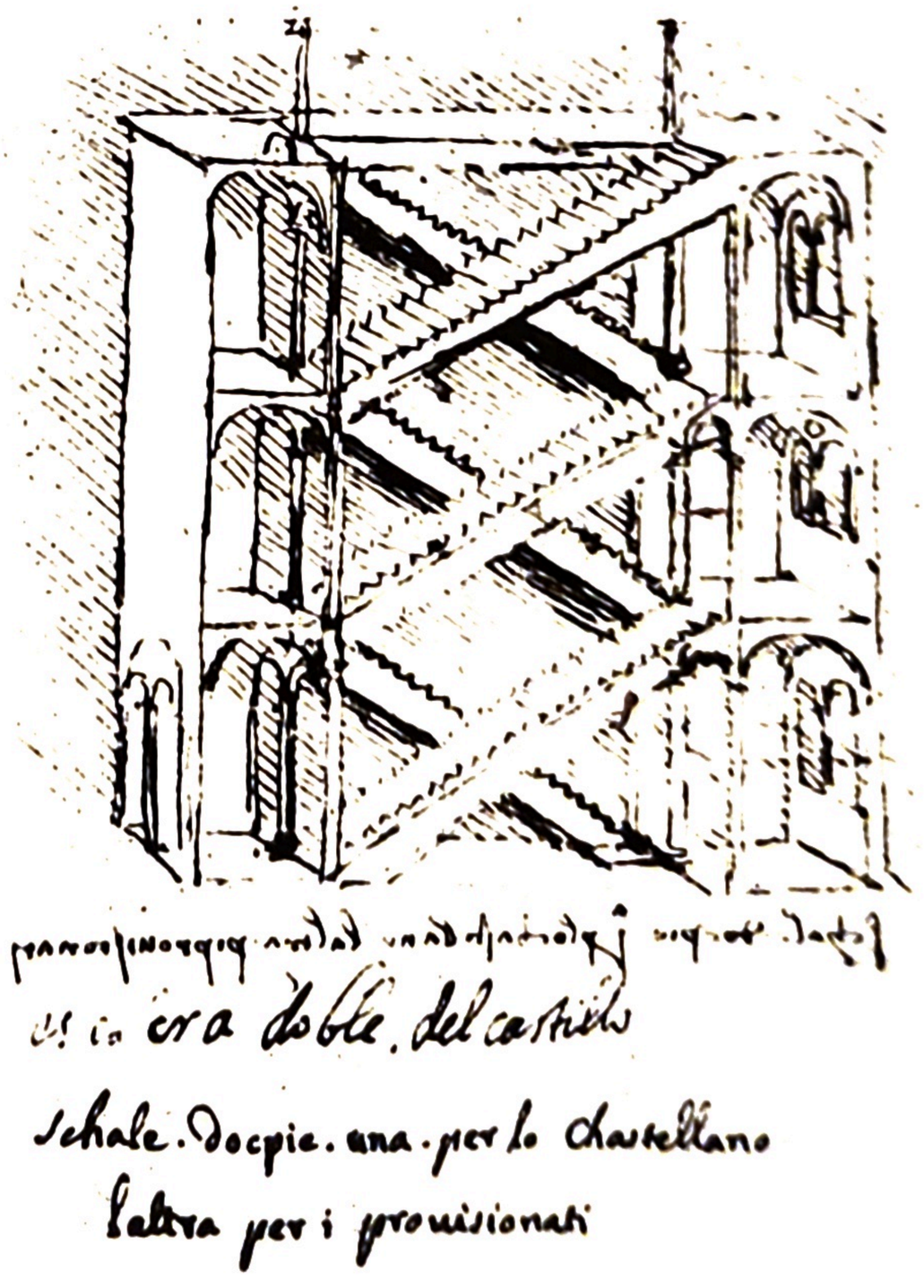
Sketches for domed cathedrals – designs which were never carried out. Leonardo was only drawn in as an adviser in architectural matters

alarm clocks, lamps which gave a brighter light by means of a glass bell filled with water, resembling a shoemaker's globe or the lamp-chimney as used in the nineteenth century.

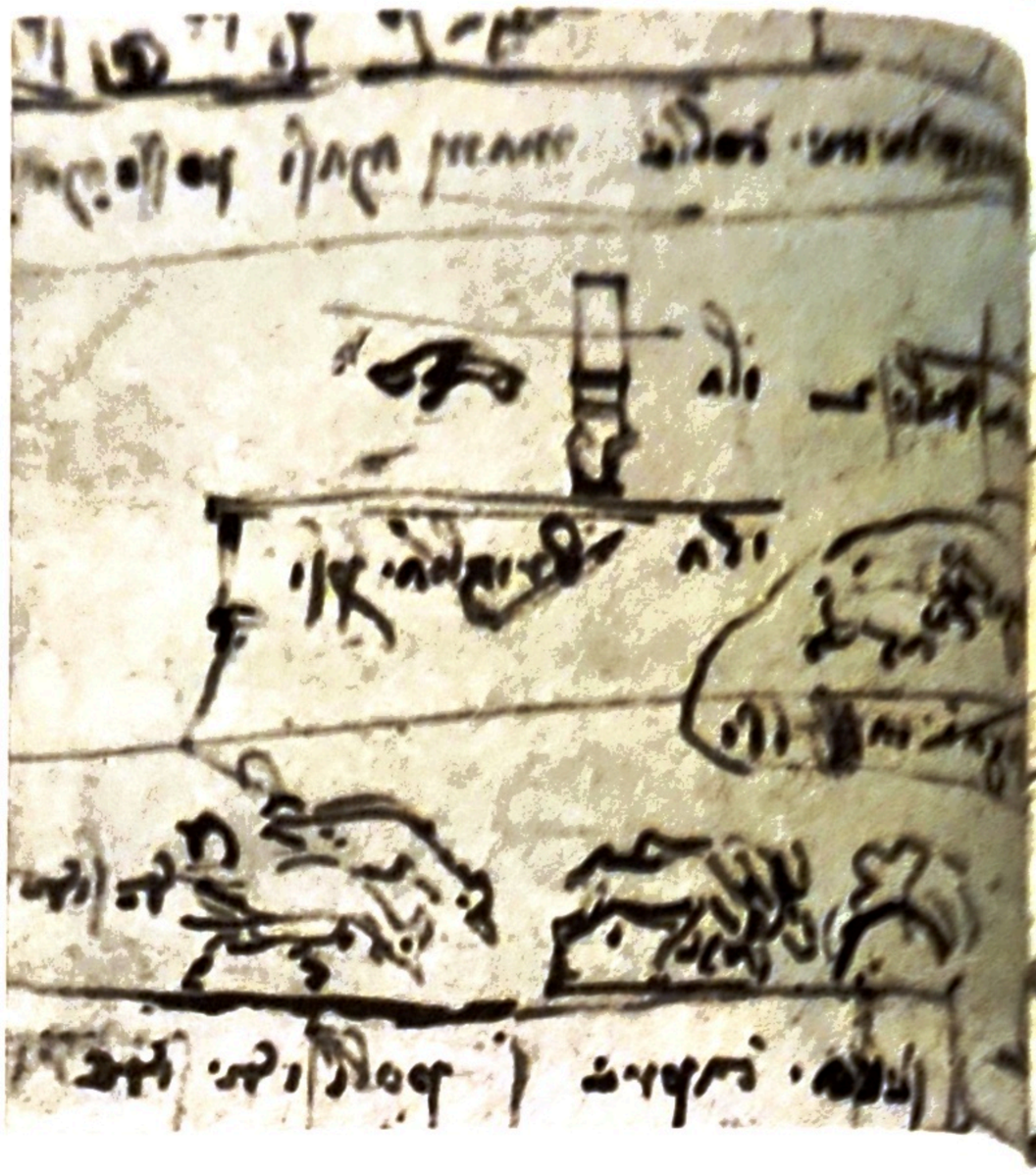
Amongst all these inventions are mingled picture-puzzles, rebus-drawings, codes and ciphers; all his manuscripts are written in mirror-writing, and this not only because he was left-handed, or perhaps ambidextrous. In one of his notes, written when he was almost forty, he remarks: 'Up to the present I have not completed a single work.' In another place: 'O Leonardo, why so much suffering?' Or again: 'Rather death than weariness. There is no work which can weary me. I am never weary of serving.' He hated sleep which he thought 'like death, and so one must create such masterpieces that after death one lives on just as much as those actually alive'.

So he went on working and filled his portfolios, notebooks and journals with thousands of drawings and ideas. They are confusing, for his own attempts to put them in order never reached beyond the initial stages. Sometimes he

Milan Cathedral. Begun in 1386, it was still under construction in Leonardo's day. His suggestion for a large tower over the crossing was not adopted

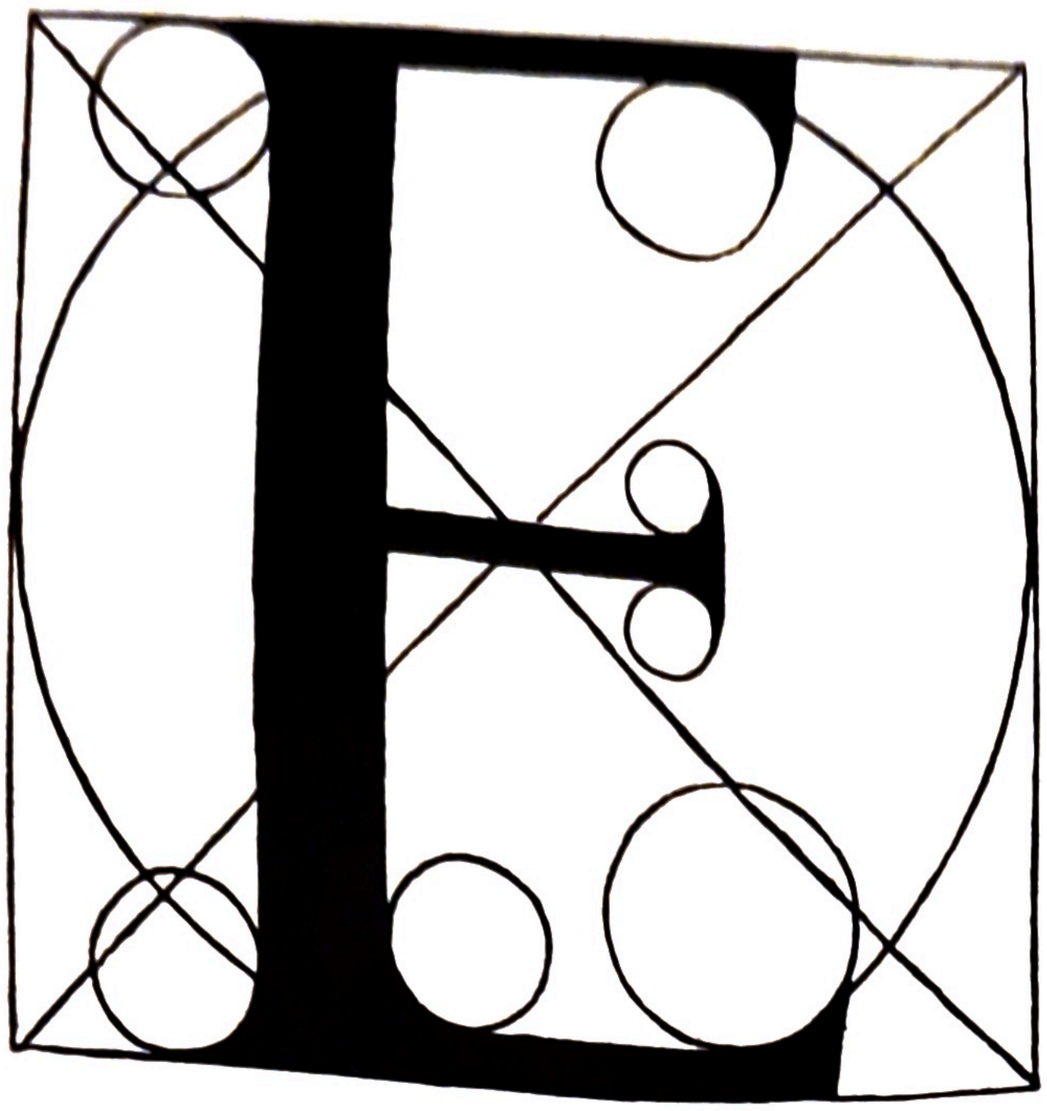


Leonardo' sketch for a house with flying double staircases, such as first came back into fashion with present-day concrete constructions



Picture puzzle: suspicion caused Leonardo to set down his ideas and inventions in mirror-writing and signs that the uninitiated would not understand

Sketch of the city of Milan; in the upper part of the sheet is a plan showing distances. *Bottom:* bird's-eye view of the city



Leonardo's designs for letters
of the alphabet
(from Pacioli's *Divina Prospettiva)*

as a theorist, for as long, that is, as it was believed that art could be learned from books.

From visual art, which he held to be the noblest of all, he went on to the organ of vision itself; he drew schematic representations of the lens and pupil and even undertook anatomical experiments. From sight he was led to the study of light, to optics, to constructing lenses and spectacles, to studies of the reflection of light in parabolic mirrors. He reached out beyond the human eye to an idea of 'eyeglasses with which to see the world magnified' — not yet the telescope, but something very near it. And since he could find none of the equipment necessary for all these as yet untried ideas, he set about constructing a machine for making concave glasses.

All these were merely projects for the future; in Milan where he spent the longest, most fertile period of his life he completed of his practical inventions only some insignificant contraptions for Lodovico's castle or model farm. In the summer of 1499 he left the city with his friend Luca Pacioli, shortly before the rule of Lodovico was overthrown.

There followed a short stay in Mantua with Isabella d'Este, the only princess who persevered with stubborn fidelity in giving Leonardo commissions and urging him to paint something for her. He drew her portrait, coldly and, to judge from the result, unwillingly.

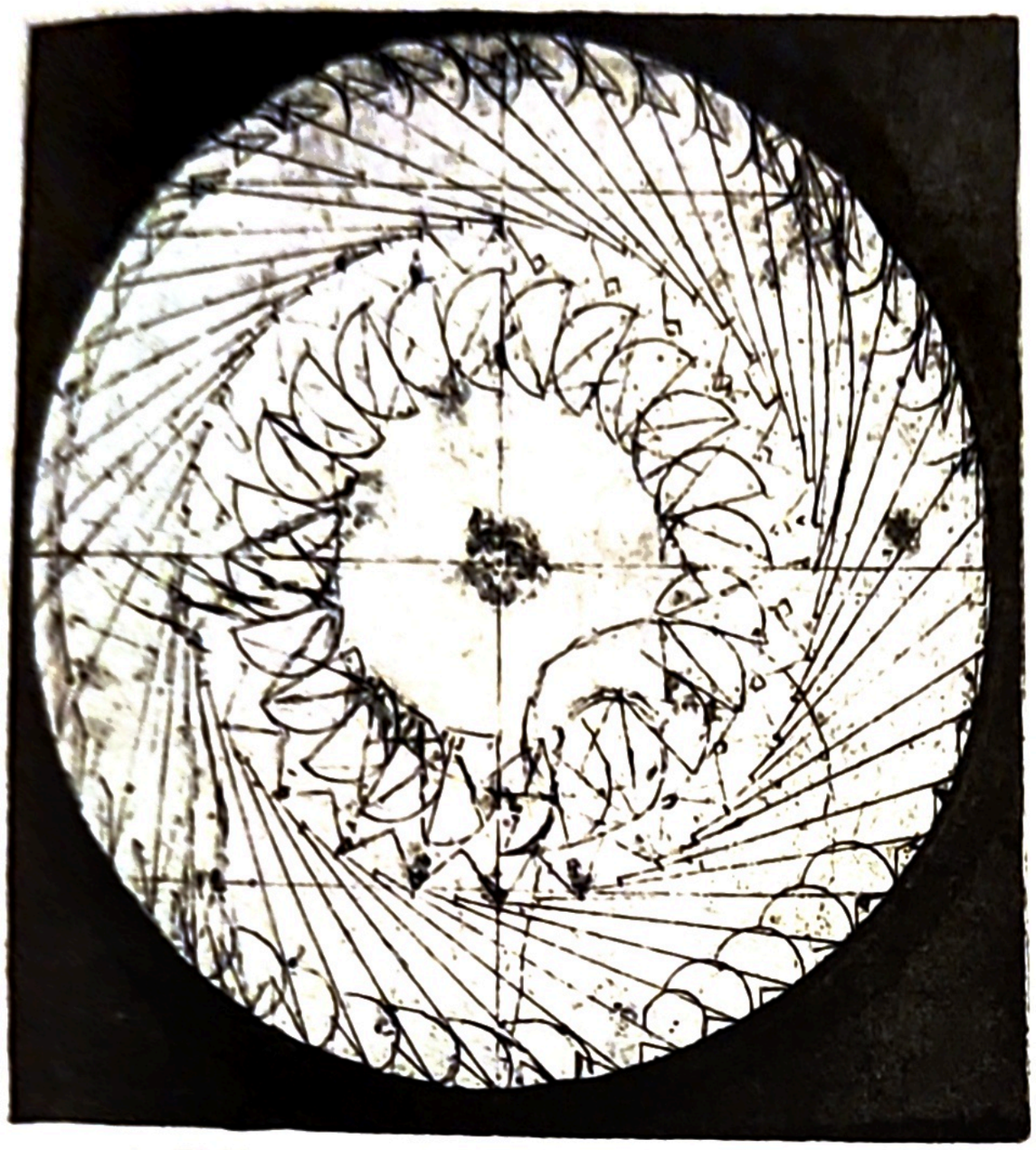
Next he moved to Venice where great tasks were awaiting him. His reputation as an engineer had come to the ears of the government of the Republic,

Nude, back view.
Chalk drawing
by Leonardo

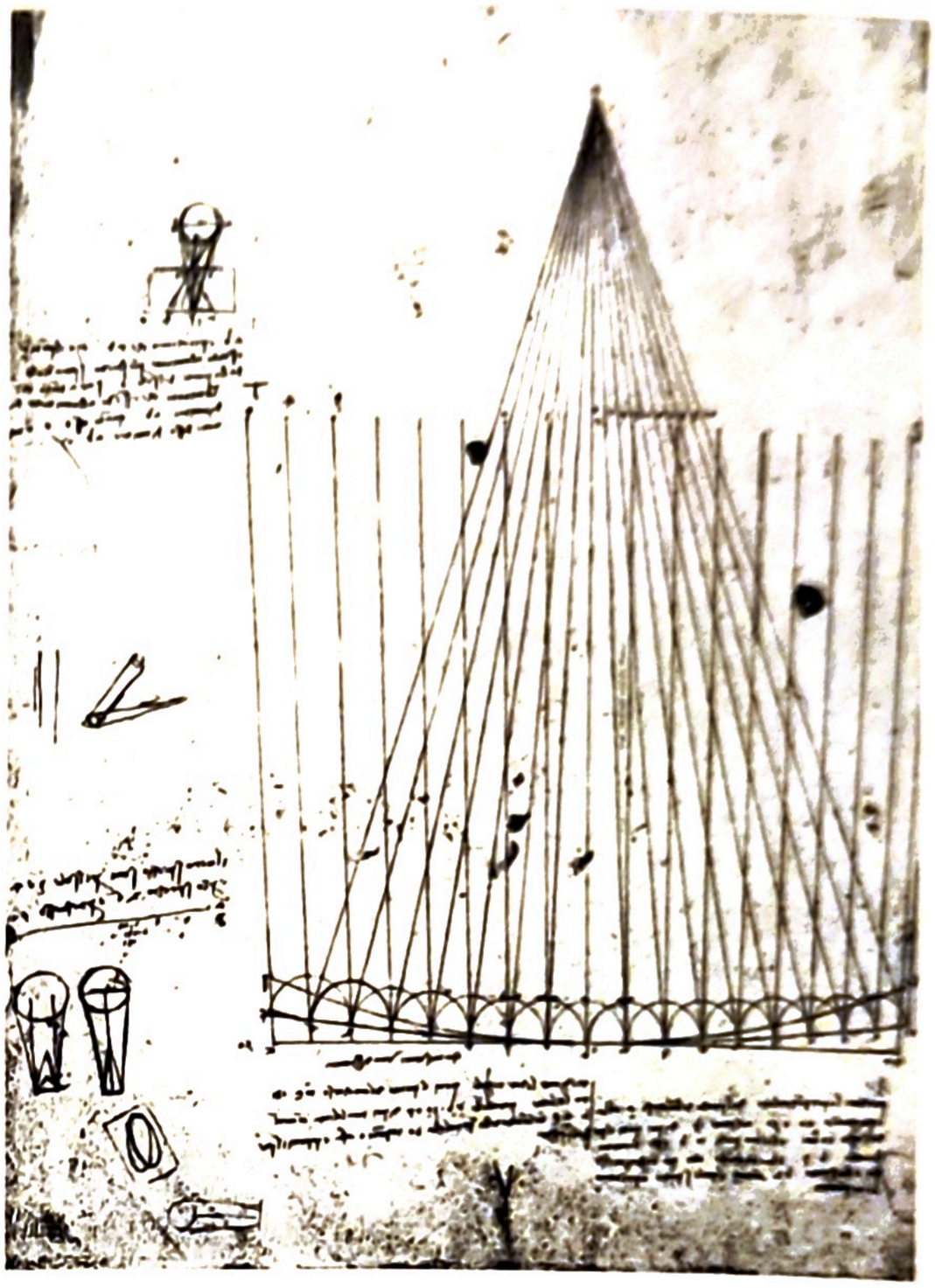
which was in urgent need of advice on matters of military engineering. The Turks were based in Friaul on the Piave; their fleet was cruising along the Dalmatian coast. Leonardo was desired to make reports and give advice on a defensive position on the Isonzo. He travelled to the battle-area, recommended the building of coffer-dams with sluice-works, constructed cannons in the arsenal and for several weeks worked only on weapons for the forthcoming naval battle.

He had high hopes of winning over the enormously rich Republic to his plans. Ironically, or perhaps pathetically in view of the disappointments soon to come, he wrote: 'The Venetians have boasted that they could spend 36 millions in gold in ten years of war with the Emperor, the church, the king of Spain and the king of France — 300,000 ducats a month.' The famous Venetian arsenal, the largest arms depot and dockyard in the West, was filled with an abundance of raw materials and of excellent workers and overseers. And so he filled sheet after sheet with ideas for attacking and sinking the Turkish fleet by completely new, surprise methods. The notion of attacking a ship under water was, of course, ancient; Aristotle had known of the diving bell, and there were divers to hand in Venice. Leonardo designed a drill for boring through the bottom of a ship; the diver was to make two holes in the planks, attach an iron windlass with lever-gear to it and dislocate the ship's bottom by means of a jack screw. The Venetian admiralty seems, however, not to have completely grasped this idea. Leonardo drew mine-boats complete with tow, gunpowder and shot consisting of small pieces of wood, and with priming-irons which were to be lit by 'flames from impregnated linen'. He constructed ramships with enormous levers to attack the enemy from below — 'but take care that the ropes which tether the two ships together can be cut at will from your side so that the opposing vessel does not drag you down with her.' Nor did he stop at his own spontaneous ideas. He made inquiries, read, studied accounts of pearl-fishing in India. Under one of his sketches he wrote: 'This is used in the Indian Sea to bring up pearls. It is made of leather and encircled with many rings so that the water shall not shut it' — that is, so that the water pressure shall not force the sides of the tube together. Above the apparatus in the picture is another fisherman in his boat. The diver is collecting pearls and coral. He wears glasses, rather like snow-goggles, and a breast-plate studded with large nails to protect him from fish or large sea-monsters. Next Leonardo turned to lifebelts, devices to which he returned when studying air-machines: 'You will test this [flying] machine over water, and you will wear a long bladder as a belt so that you do not drown if you fall in.'

He designed life-saving shields, again for 'attacking below the surface of the water', and a sort of one-man submarine, entirely covered in and with a leather air-tube closed by a lid; he devised life-jackets and bullet-proof vests



Design for a turbine wheel



The reflection of rays in a curved mirror

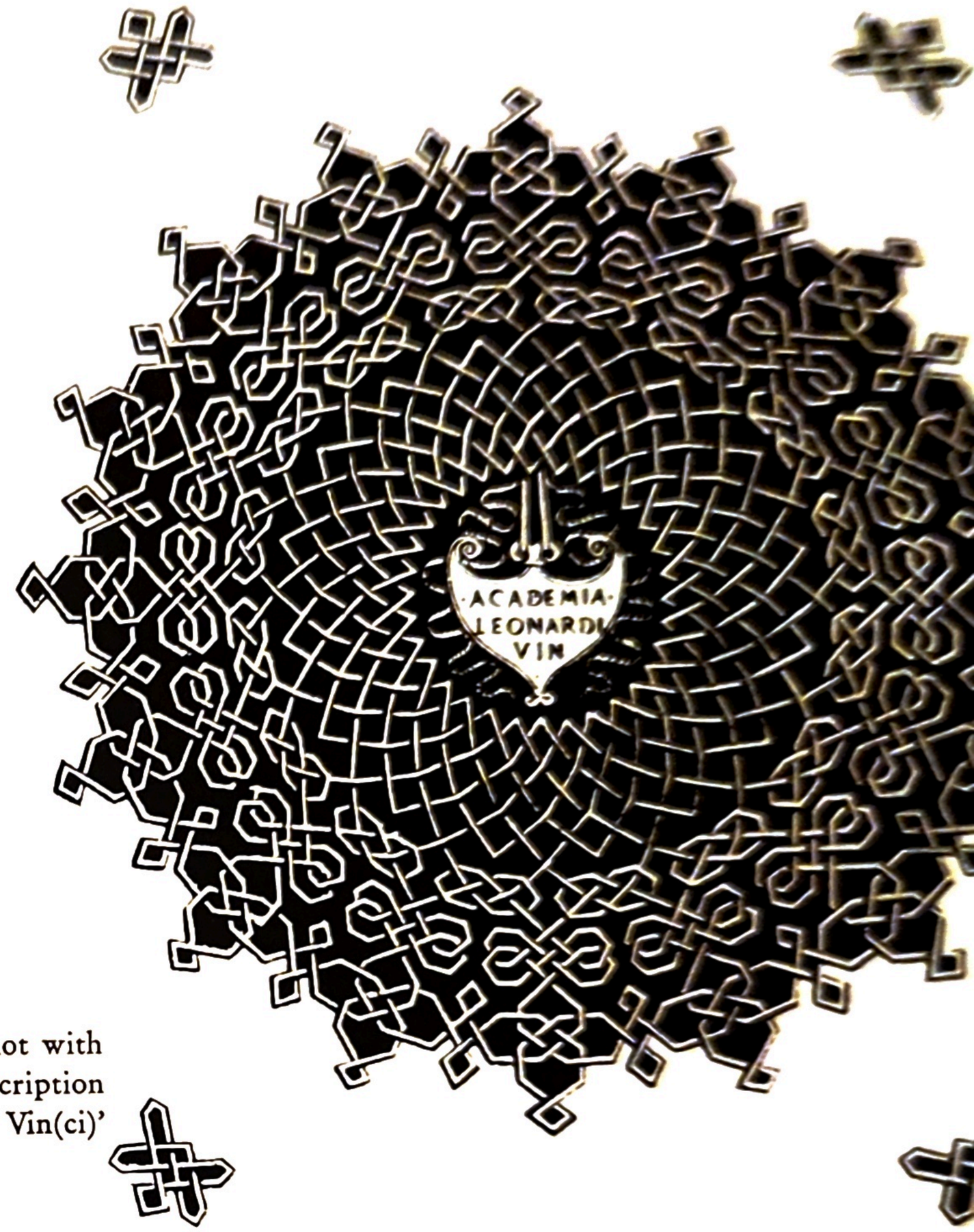
of iron chain-mail for singlehanded combat under the water with daggers. In these weeks in Venice it was as though he were overcome by a fever of invention; he made a point of exhorting himself to be careful: 'Show this to no-one and you alone will have all the credit for it! Engage a very simple assistant and have the jacket sewn at home.'

It was not easy to find 'simple' assistants. He wrote bitterly of his two mechanics, Georg and Johannes, whom he later used in Rome, saying that they were trying to steal his ideas: 'Georg did nothing without consulting with Johannes every day, and he was always describing his work to him, giving himself out to be the inventor of the idea.' Or: 'I can complete nothing in secret . . . if I showed him no more than a hundredth part of my work he would immediately make it public.'

Most of his ideas remained on paper but more and more of them proliferated from his fertile brain. He even worked out the time necessary for the complete destruction of the Turkish fleet and rehearsed an ultimatum to it in his notebooks: 'If you do not surrender within four hours we shall send you to the bottom of the sea!' He added, gloatingly, 'I shall lay waste the entire harbour!' A true son of his precise, detail-conscious father, he calculated his share in the great booty to be taken and the measures necessary to make sure that he was

on proportions, *Instruction on Measuring with the Compasses and Rule*, and said of it in the preface to the Latin edition issued after his death that it had 'raised mere rule of thumb to the level of a scientific system'. It was an age of discoveries; those of Columbus and Magellan were by no means isolated cases. Artists believed that they had found a New World of their own by means of the new scientific picture of the world which they expressed in the one word 'mathematics'. Precise measurements and constructions using compasses also played a part in the new script developed by the humanists and adapted for printing purposes. The Latin script now used all over the world was born at this time. A symbol, as it seemed, of the renascence of antiquity, it gradually supplanted the Gothic script and type. Leonardo was not the first to envisage it; he was proceeded by Nicola Jenson, Wendelin von Speyer, and Miscomini. But his character-designs for Pacioli's work are amongst the finest, noblest

Leonardo's delight
in intertwined pictures,
knots and plaits
is evidenced in the painted
ceiling of the
'Sala delle Asse'
in the Castello Sforza

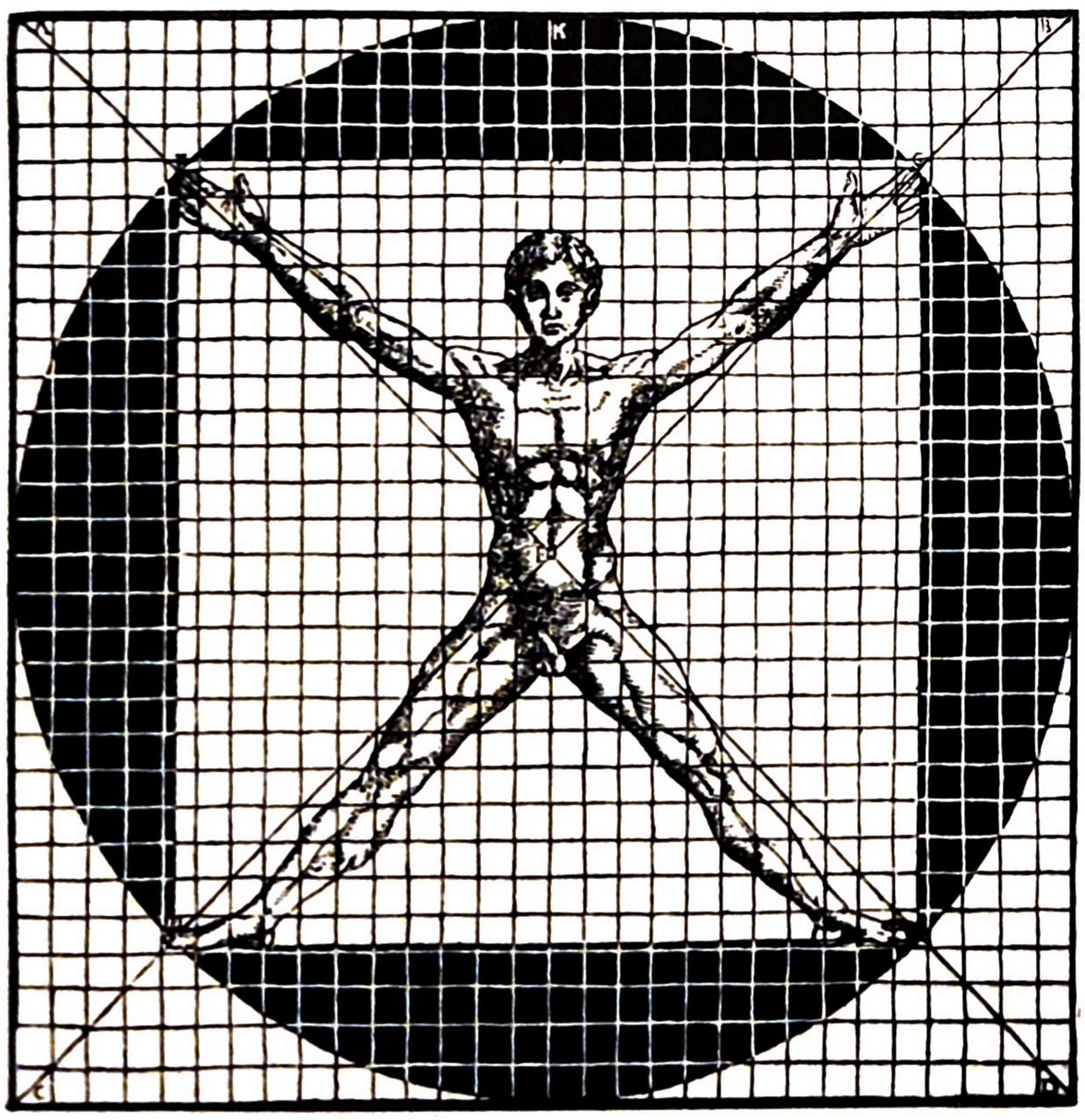


A plaited knot with
the inscription
'Academia Leonardi Vin(ci)'

approaches to the problem. The French master-printer Geoffroy Tory, when he fought his decisive battle for Latin script in France with his book *Champfleury*, referred admiringly to Leonardo and in his enthusiasm accused Pacioli of having purloined Leonardo's splendid designs.

Leonardo worked not only with compasses and rules. Using models, he pursued his brilliant studies of the human form and played with the idea of making his conclusions public. The beginnings of his book *On Painting* which he never finished also belong to this period. His notes begin with a comparison of the merits of the various arts, in which painting eventually bears the palm. 'It does not have to be cast like a sculpture, in which the whole merit depends on the copy resembling the original. Nor does it give birth to a multitude of descendants, like printed books. It remains quite alone, perfect in itself . . .' The painter is 'lord over people of every kind and over all things'. And the

Leonardo's drawing of a polyhedron for his friend Luca Pacioli's book *On Divine Proportion*. *Below:* proportional delineation of the human body from the Vitruvius edition of 1535



painter works like a lord, unlike the sculptor, the inferior artist 'whose face is smeared and powdered with marble splinters as though it had snowed on him'. The painter 'sits in great comfort before his work, well dressed, manipulating his light brush and splendid colours. He wears whatever clothes he chooses. And his quarters are full of gay paintings and brilliantly clean. He entertains much . . .'

It is intriguing to think of Leonardo in his studio, wearing his pink coat, his beard carefully tended; it was not until much later that the paint-spattered smock, the artist's uniform, came into use. The book *On Painting*, as it stands, is a discussion in which he carefully reveals all the points for and against, all the light and shade of, painting. And his opinions on light and shade are amongst the most important of the later remarks; he believed that shade was measurable, determinable: 'If you cannot determine these ascertainable points you will have no depth in your work, and depth is the soul of painting.'

He had planned to write ten books, or sections; like Wagner with his opera-scores, Leonardo always planned the arrangement and division of his works beforehand. But like Mr Lewisham he never completed the scheme. All that remains to us are single, often quite short, observations or precepts, practical tips — even as to the games which should be played in a painter's studio — and personal reminiscences of his own experiences. The last-mentioned are the most

Jacopo de Barbari's portrait of Fra Luca Pacioli

valuable to us today, giving us an insight into his methods of work, as for instance when he says that it is useful to reconsider, mentally, the surface pattern made up by the figures of a picture when one is in bed, in the dark. And there is a highly characteristic passage on the hypocrites who reproach an artist for working on holy-days: 'Such fault-finders would do better to be silent. For to do this [work on holy-days] is the way to become ever better acquainted with the Creator of so many miraculous things and to learn to love the great Inventor.' These are almost the same terms in which the 'great architect of the Universe' was spoken of in the Age of Enlightenment.

Even in the incomplete state in which Leonardo left it, the book was much copied and circulated freely; as early as the seventeenth century it was printed, translated and published in many editions. Though almost none of his paintings and few of his drawings were known he had a flourishing reputation

Leonardo's life was not without its incidents and bizarreries while he was working on his two main works. One cause of these was provided by a boy whom he took on as one of his assistants, one Jacomo, known as Salai. 'On St Magdalene's Day 1490 I engaged a boy of ten years old called Jacomo. Two days later I had two shirts, a pair of hose and a jacket made for him.' It would appear that Salai was not over-burdened with worldly goods. 'When I was putting aside the money to pay for these things, he stole from my purse – Thief! Liar! Stubborn mule! Glutton! It was impossible to get him to confess, although I was quite certain he was the culprit. On the next day I went to supper with Andrea da Ferrara and Jacomo came with me. He ate for two and made a nuisance of himself for four, broke three bottles and spilt the wine.' At the end of his first year, Leonardo made up a sort of account of his expenses for the boy. One entry refers to twenty-four pairs of shoes which Salai had worn out during his wanderings. Even eight years later he was still writing: 'Salai steals the money.' Yet Leonardo kept him until the end of his life in Italy; he gave him permission to build a house on the vineyard that

Last Supper, painting by Andrea del Sarto

Lodovico had given him and bestowed half of this property on him in his will. Vasari wrote that Salai 'was charmingly attractive and beautiful; he had wonderful crisp, curly hair which Leonardo liked very much . . . Many of the works which are supposed in Milan to be by Salai were in fact improved and completed by Leonardo.' Leonardo was also thought to have worked on the profile of a lady of Milanese society which was really by Ambrogio de Predis.

The ceiling decorations in the Sala delle Asse in the Milan fortress were executed by his assistants. They date from the last year of Lodovico's reign and form an intricate tangle of branches, tendrils, knots and cords with plaques bearing ostentatious inscriptions testifying to the Duke's multifarious political intrigues. Leonardo had often sketched similar subjects in a more delicate form and strict geometrical pattern as they were used in calligraphy or as decoration for the bindings of books. A pun on his name (*vinci* = willow, wickerwork) may have led him to consider these patterns as a sort of secret crest or coat of arms. A series of them was engraved while he was still alive, with the rather mysterious inscription 'Accademia Leonardi Vinci' (he never founded an academy in the more usual sense of the word; the relations between him and his pupils and assistants was always free and easy). These intertwining patterns were studies, *jeux d'esprit*, a visual *Art of Fugue*. Similar motifs can be found in the wickerwork patterns on Romanesque pillar-capitals and miniatures, and in Oriental art. But Leonardo's designs bear the unmistakeable imprint of his character: they are carefully thought out, mathematically constructed, symmetrically arranged. They neither spread beyond their limits nor lose themselves in inessential squiggles.

It was his mathematical interests which brought him into the company of the man who was considered his best friend by those who knew him in Milan — Luca Pacioli, a Franciscan monk of the same age as himself, a professor of mathematics at Pavia and Milan and a great art-lover. Not, perhaps, what the founder of the Order would have considered a Franciscan, Pacioli was a worldly-wise, ambitious man, unscrupulous with regard to the ideas and inventions of others. Vasari accused him of having stolen and given out as his own the important discoveries made by the painter Piero della Francesca who later went blind. Others accused him of putting Leonardo to the same use, but this can hardly be true. In his book O*n Divine Proportion* Pacioli spoke of his friend in terms of high praise. Leonardo drew the originals for the illustrations in Pacioli's book: these were composed of polyhedrons, which at that time had a magical, mystic significance and allure quite apart from their purely geometrical function. A similar polyhedron appears also on Pacioli's portrait, like a shining scientific symbol. It was through Pacioli, or in association with him — it is hard to lay down a clear line of demarcation — that Leonardo's

Court lady with pearl [illegible]
Oil painting in [illegible]
Milan Ambrosia[illegible]

Drawing of the head of a young man, perhaps representing Salai, Leonardo's friend and pupil

attention was drawn to the proportions of the human body and their measurability in terms of mathematical units. He attempted to lay down a 'canon' of rules, using compasses and squares. 'No study of man can be called scientific,' he wrote, 'which is not susceptible of mathematical proof and explanation.' Science, then known as 'the exact sciences', later became completely differentiated from the arts, but in Leonardo's period their paths were only beginning to diverge. He wrote, defiantly, almost belligerently: 'Nobody who is not a mathematician will be able to understand the basis of my work.' To him 'mathematics' conveyed the idea of a concrete, demonstrable symmetry in all matter: 'Proportion is found not only in numbers and weights, but also in sounds, scenery, time, movements, and every possible kind of phenomenon.'

The canon of the human body, as Leonardo drew it, found its way into many works of the day, in particular the publications of Vitruvius, from whom the first impulse for such a scheme had come. Dürer adopted it in his treatise

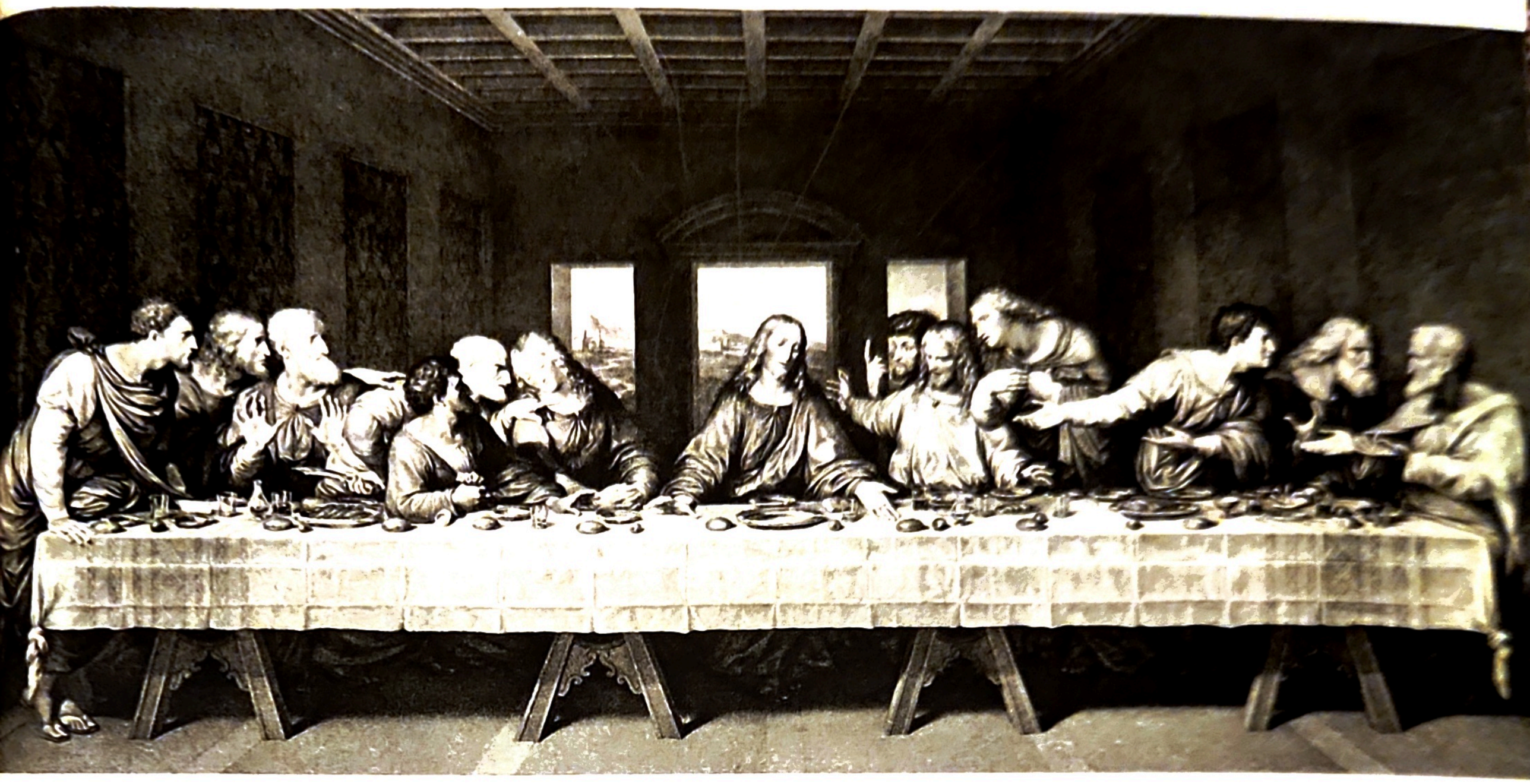
nature, ever reaching out into infinity, found in this particular picture a task which gripped him and held his attention until it was complete.

Giambattista Giraldi, the novelist, gives a description of Leonardo's methods of work as remembered by his father: 'When he decided to paint a figure he first made up his mind exactly what class and type he wanted . . . When he was clear about this he carefully visited the places where men of the kind he required could be found. Then he attentively studied their faces, posture, movements and behaviour. When he had found somebody suitable for his purpose he drew him in pencil in the sketchbook which he always wore at his belt. He repeated this as seemed necessary for the picture that was taking shape in his mind. Then he set about combining all these figures into a composition. And in this he was miraculously successful.'

All this sounds easy and even, for us of a later generation, obvious. But in the workshops and studios of Leonardo's age it was by no means usual to copy nature with such careful fidelity; many artists, like Leonardo's schoolmate Perugino, spent their whole lives painting and re-painting a single type in which they had been successful. Leonardo never repeated himself in his pictures, but looked on each individual one as a completely new task. He took care to achieve the greatest possible variety in his figures, the maximum contrast of character and movement. Amongst the advice he gives in his treatise is: 'Men's movements are as various as the emotions which trouble them — and each emotion stirs men to different degrees . . .' And in another place he speaks of the effect of contrasts: 'Set the ugly by the side of the beautiful, the great by the small, the old man by the youth, the strong by the weak, and thus obtain as much variety as possible and in as close apposition as possible.'

It is this density and variety in the figures which gives the *Last Supper* its richness: Judas, the traitor, next to John, the good and fair, old men next to young ones, excited faces next to calm ones. For us, who can no longer appreciate the novelty of the picture after seeing so many imitations and repetitions of the theme, the total effect of the composition is one of great peace and simplicity, of concentration on the main theme to the exclusion of all distractions.

Legends and anecdotes immediately grew up round the work. Giraldi writes of the monks' impatience when they saw the head of Judas remaining incomplete for so long. They complained to the Duke who took Leonardo to task. The painter answered that he spent two full hours on the work every day. The monks, on the other hand, declared that he had not even looked at the painting for a year, let alone worked on it. 'What do these monks know of painting?' answered the master. 'It is quite true that I have not been there for a long time. But they are wrong when they deny that I have spent at least two hours a day on it. Every day, morning and night for a year and more,



Leonardo's *Last Supper*, after an engraving by Raphael Morghen (about 1800)

I have been going to the Borghetto where humble and abandoned creatures live, mostly wrongdoers and criminals, all in order to seek out a face suitable to represent that of Judas.' He added scornfully that if necessary he would use the prior's face: 'He would be amazingly suitable.'

The writer Bandello who at the time of the painting was a young monk at the monastery, tells, from his own observation, that Leonardo used to climb the scaffolding in the early morning. 'From sunrise to twilight he did not put down his brush or think of eating or drinking but painted without interruption. Then perhaps two, three or four days would elapse without his touching the picture. But even so he would spend one or two hours there looking at the figures, reflecting and coming to a decision after turning the matter over in his mind. According to his humour, I have seen him go from the Corte Vecchio where he was sculpting the amazing horse, straight to the monastery at midday when the sun stood high in the sky. There he climbed his scaffolding, painted a few strokes and immediately went away again.'

This was how the work of painting appeared to outside spectators. But the

The Disciple James the Elder. Sketch for the *Last Supper*

majesty that when he came to Christ he could not, despite exerting all his amazing powers, bring the holy face to completion and perfection. So he went to Bernardino Zenale (an old Lombard painter) to ask his advice. He said to comfort him: "O Leonardo, the error which you have made is so great that only God can undo it. Resign yourself and leave Christ incomplete, as He now is."' The story continues: 'Thus did Leonardo, as can still be seen, although the painting is much damaged.' These remarks date from 1560. The misfortunes of the *Last Supper* had already begun by that date, in fact even earlier. Leonardo had not used the usual, tried and tested fresco technique, applying the colour direct to the fresh *(fresco)* plaster when it was still wet and allowing the whole to dry out together, but had experimented with oil tempera. It was not long before the colours began to peel off the wall, a catastrophe which was speeded by the fact that the monastery had been hastily and badly built. Goethe, who had a sharp eye for such details, described the outside walls and corridors thus: 'Uneven, damaged bricks, materials taken from old demolished buildings. If such errors have been made in externals, visible to any beholder, it is to be feared that the inner walls which are whitewashed over have been even worse constructed. Moreover the wall to which unfortunately this great treasure was entrusted faced north and was near the kitchen, the dining-room and the pantry. It is sad that such a careful artist who could never take enough care in choosing and preparing his colours and perfecting his varnishes was forced by circumstances to ignore, or not sufficiently appreciate, the positioning of his picture, the main consideration on which its survival depended.'

Goethe on 'The Last Supper'

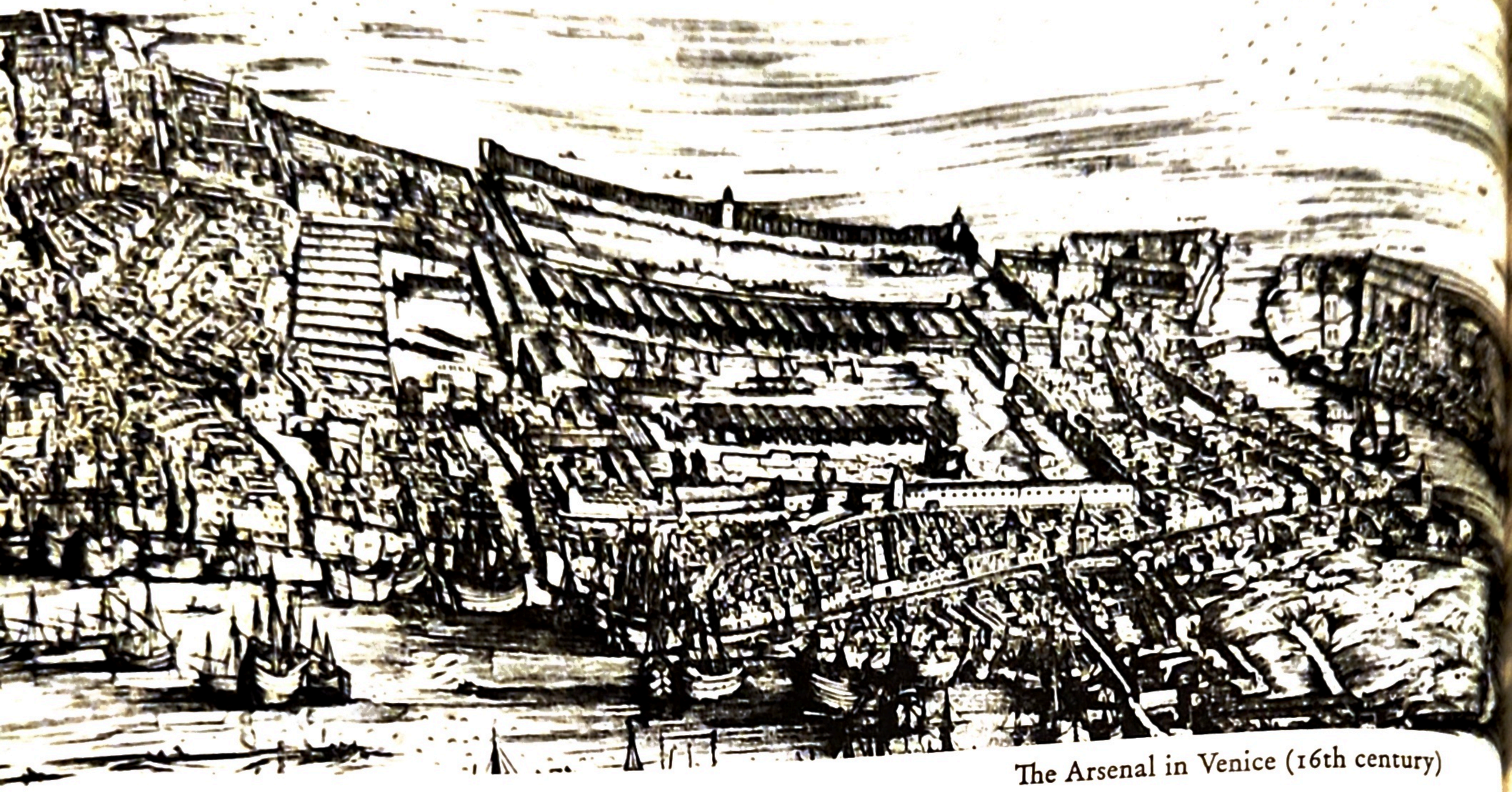
It was not long before people began to restore and paint over the picture as it stood. The monks themselves were the first to commit the barbarism of cutting a door in the wall in the very middle of the painting. In Napoleonic times the refectory was used as a stable. The administration of the monastery had the room temporarily walled up so that the picture, which always remained one of the town's greatest attractions, could only be seen and admired from above. The very careful restoration work of recent times has at least preserved what remained of the picture and removed the worst of the later additions. Even in its present form the greatness of the original can still be seen, although it is true that the delicacy of the facial expressions has been lost.

The *Last Supper* made the deepest possible impression on contemporary artists, who tried again and again to reproduce it, the greatest model yet set before them, in new versions of the same theme. None of them attained its sublimity and deliberate renunciation of all distracting sub-themes. The only attempt which approached it, however distantly, was painted by a member of Raphael's circle, Andrea del Sarto. It is pictorially charming, a fine living composition, yet combined with a little genre picture.

'Began at Florence on 22nd March 1508. And this will be a collection of the many papers I have copied here arranged in no precise order; later I hope to put them together, systematically, according to the material concerned . . .' As though with an idea of publication, he drew a model of a new kind of printing press with cog-wheel controls and a sloping platen so that the paper could slide off easily. In the end, however, his scheme was never carried out; the papers were never arranged 'according to the material concerned'. Leonardo aged quickly. When he was still in his fifties he impressed his contemporaries as an old man, a majestic, awe-inspiring figure. Raphael portrayed him as Plato in *The School of Athens.*

He went back to Milan. The last phase of his life was passed in curious rhythmical periods of three years each: Milan, Rome and finally France. If these moves seem to indicate unrest, they were paralleled by the turbulence of European political affairs and events in Italy. The battles of these years took an unprecedented toll of men, unlike the cautious manœuvres of the Condottieri, which they resembled only in their swift changes of front and unscrupulous treachery. Leonardo went his way completely unmoved through all this, as though charmed. In Milan he painted his last pictures with the help of the pupils who now gathered round him. The paintings of this period have a strange indistinctness; they portray visions rather than reality. There is a *Bacchus* and a *John the Baptist,* almost indistinguishable from one another

The head of Plato in
Raphael's *School of Athens.*
Many regard this as an
idealised portrait of Leonardo



The Arsenal in Venice (16th century)

not baulked of it: 'First you must present them with a written agreement stating that one half of the prize-money belongs to you, and that no deductions are to be made.' He considered whom he should entrust with this delicate transaction and decided on Alvise Manenti, Venetian ambassador to Constantinople, writing: 'Menti shall be authorized to deal with the exchange of prisoners and the payment – that is, the aforementioned prize-money – shall go to him for safe-keeping.'

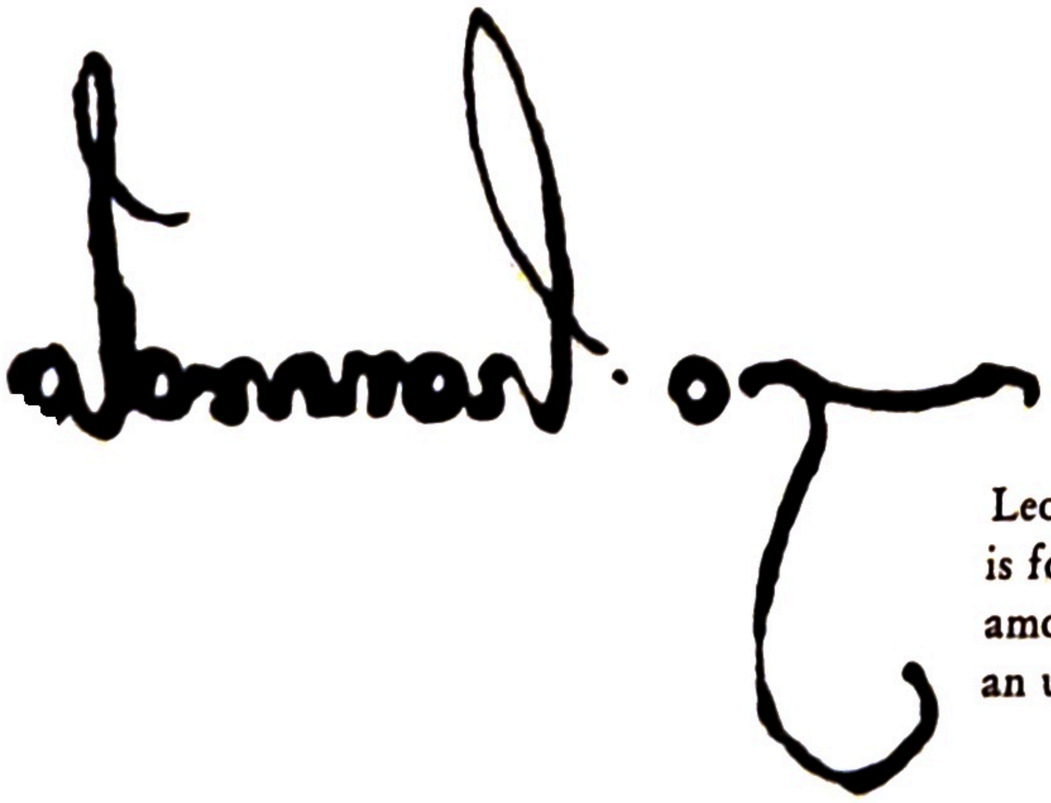
The Venetians were not particularly interested in their inventor's claim to have 50% of the booty which was not yet even captured. They were good businessmen. They calculated the cost of Leonardo's ideas for field-fortifications on the Isonzo and found it to be too high. Though they possessed outstanding workshops, shipwrights and engineers, they were not very taken with the idea of completely rebuilding their fleet, apart from the fact that it would take an excessively long time. Time, of which Leonardo often speaks, is the factor that he never included in his accounts. Resigned, he wrote: 'As to whether all these qualities will be found in me, the final judgment will be passed by the hundred and twenty books I have written. For in them I was hindered neither by excessive zeal nor negligence, but merely by lack of time.'

his works. To our eyes it appears perfectly complete, although he, never satisfied, explained that he still had work to do on it. Unlike the majority of his works it was actually exhibited to the public, and it was seen by a large number of people. The fame which had begun when news of his Sforza monument spread abroad took on a more permanent character. From now on he was one of the uncontested leaders, if not the supreme leader, of Italian painting. Artists came from every part of Europe to study, copy and discuss the painting in the refectory of the monastery of Santa Maria della Grazie. After his entry into Milan the king of France played with the idea of detaching the fresco from the wall and taking it to France. Legends grew up round the painter and his creation even while work on it was still in progress. The story of this picture and its painting crops up even in the tales of Bandello and Giraldi which are really composed of quite different material — love-stories and anecdotes about criminal outrages.

Basically the project was modest. The Dominican monastery of Santa Maria lay near the palace; it was the Duke who had had the church built. In the brothers' refectory there was already a *Crucifixion* to which Leonardo added a picture of Lodovico, as patron, and his wife and two sons in the lower section. He also collaborated on the medallions and wall decorations which included the arms of the Sforzas, garlands of fruit and clusters of palms, as though he wanted first to warm up before beginning on the main task.

Many years later, Goethe, who saw the room in comparatively unaltered condition, gave a description of it: 'Opposite the entrance on the narrow side, at the back of the hall, stood the prior's table flanked on either side by those of the monks, all of them slightly raised above the level of the body of the hall. And if the visitor turned round he could see on the fourth wall, over the fairly low doors, a painting of a fourth table at which sat Christ and the disciples as though they were present in the room. It must have been an impressive sight when, at meal-times, the tables of the prior and of Christ faced each other while the monks at their tables were enclosed between them.'

Leonardo worked on this, the greatest of his works, more swiftly and continuously than ever before, for about three years. In some way his restless



Leonardo's signature in mirror-writing. The signature is found only rarely and arbitrarily distributed among his sketches – as if it served as an unimportant exercise in writing

In this contempo
portrait Leon
is about 50 years
He had the appear
of an old
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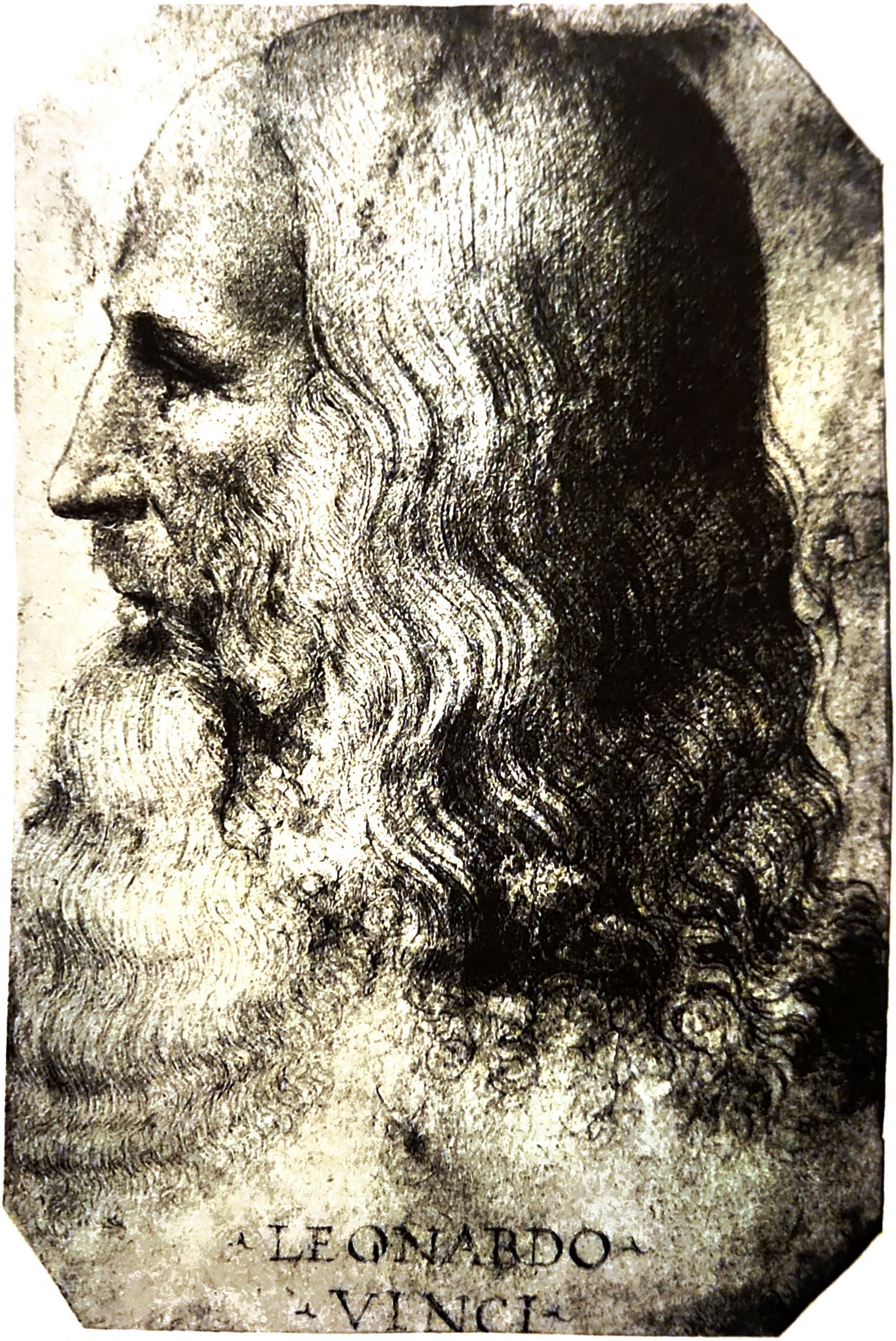
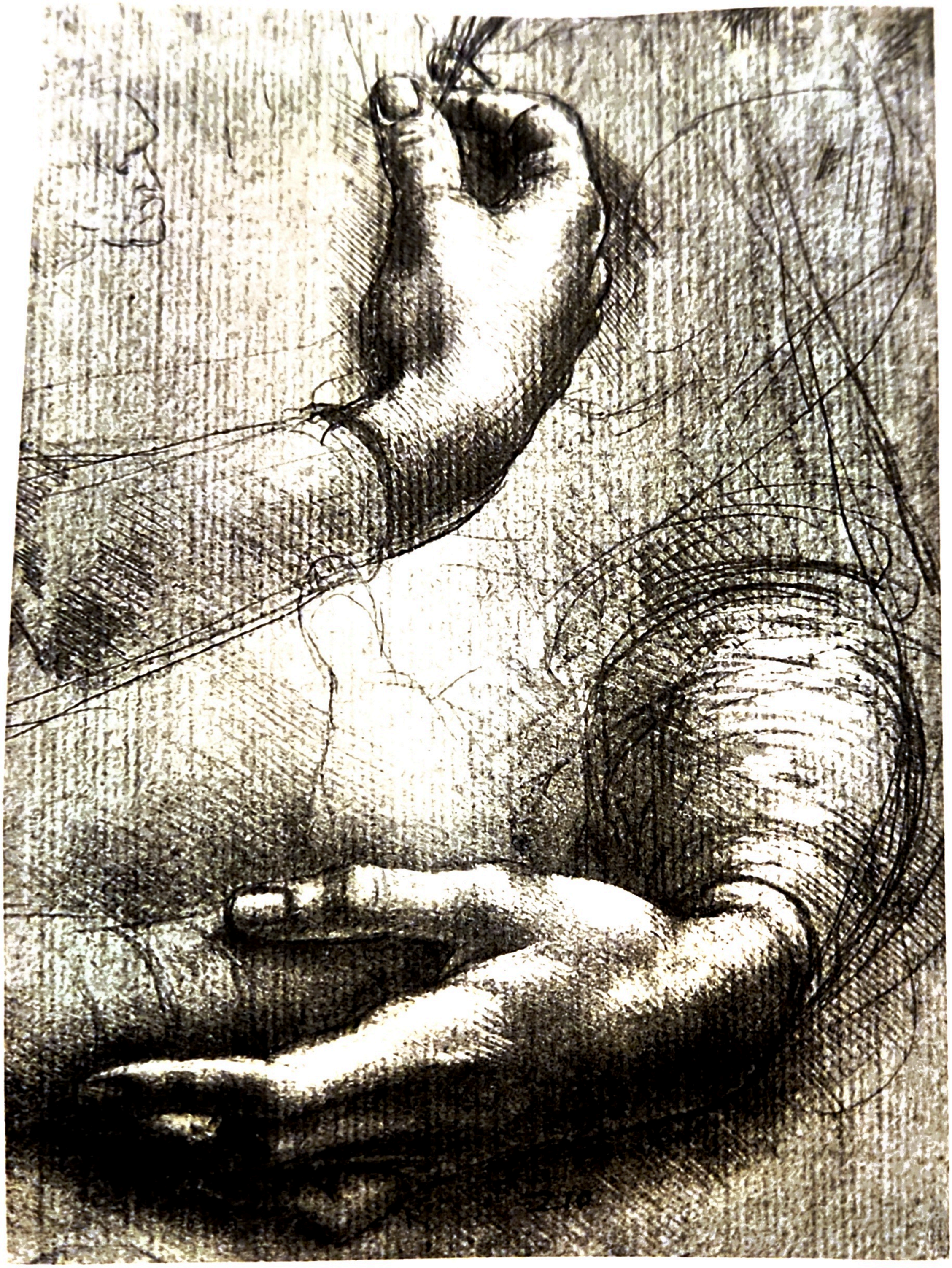

LEONARDO
VINCI

provided a subject for an opera, *La Gioconda*. It was renowned already at the time of its painting; the young Raphael learned much from it. The sitter's smile in itself has stimulated a whole literature. It has been thought by some to be cruel, the pitiless smile of the female subduing the male, while others have seen in it radiant charm, or the 'soul with all its maladies', as Pater wrote. The simplest explanation, given in Leonardo's own account in his book on painting is that he kept his model amused with lute-playing and reading aloud so that she retained this expression. Vasari also says: 'Mona Lisa was very beautiful and Leonardo took the precaution while painting of always having someone by to sing, play or provide amusement. Thus she was always in a good humour and never took on a sad, weary appearance.'

The little that is known of her life is reminiscent of an old Italian tale: she was a young girl without a dowry who married an elderly man of noble family who had already buried two wives. She gave birth to a daughter who soon died, after which they had no more children. She was about twenty-five when Leonardo began the portrait and as he worked on it for four years she was thus nearly thirty, a mature woman, by the time it was finished. The portrait shows her in a dignified upright position; it was considered a virtue in Florence for a woman to 'sit up straight.' She is curiously, almost shockingly, simply dressed for the wife of a nobleman, wears no jewellery and her head is encircled with a narrow band while a fine veil covers her chestnut hair. She seems almost to be dressed in mourning. It is also remarkable that the picture was not commissioned by her husband, that, in fact, it is not known to have been commissioned at all. Leonardo kept the picture and took it with him to Milan and then to France where François I bought it for 4,000 gold pieces. It was most unusual at that time for a portrait which had taken four years and immense care to produce to be initiated by and remain in the possession of the artist; *l'art pour l'art* was a concept not yet dreamed of. But the mysterious smile which has caused so much speculation was not original to this portrait. It can be seen hovering round the lips of many of Leonardo's sitters. It is not Mona Lisa's mystery, but Leonardo's.

In any case, it is not a smile in the common sense of the word. It is rather a spiritual state, the moment when a feeling, a mood, begins to be felt and to express itself, a tiny fleeting moment of movement, tension showing itself on the face. It is this which gives the face its incomparable liveliness, underlined by the cold, almost stiff, position of the body and recaptured in the soft, expressive hands. Early in life Leonardo had worked on drawings which might be taken as preparatory studies for Mona Lisa's arms. In fact the picture was a summing up of all the skills that he had learned and practised through the years. Every generation and every spectator will interpret the picture according to its or his own feelings. In this lies its greatness.

Mona Lisa,
Louvre



With these two works, the *Mona Lisa* and the *Battle of Anghiari* Leonardo's Florentine period, his last period of great artistic creations, came to an end. It was followed by years of unrest, of wanderings and of a final great upsurge of his interest in science, now concentrated mainly on anatomical studies. Once again he left his native town without any qualms. The parting was made easy for him. Charles d'Amboise, France's envoy to Milan, was angling for his services and there was a long exchange of letters between him and the Republic of Florence. King Louis XII himself took a hand in the affair and Florence allowed Leonardo to be spirited away. With much precaution the town had demanded a security of 150 guilders for the uncompleted *Battle of Anghiari*. Leonardo entered the service of the French royal house as Court painter and architect. D'Amboise made sure that he retained the vineyard given him by Lodovico, a share in the water-rights was allotted to him and a salary paid him. The returns he made, on the other hand, were modest; he himself said that he had 'responded to great benefits with small services' and stated that he was to paint two Madonnas for the king. It is not known whether they were ever finished. But in any case the royal family continued to hold him in high favour though he was continually leaving Milan and even spent three years in Rome which was at that time France's enemy.

In the service of France

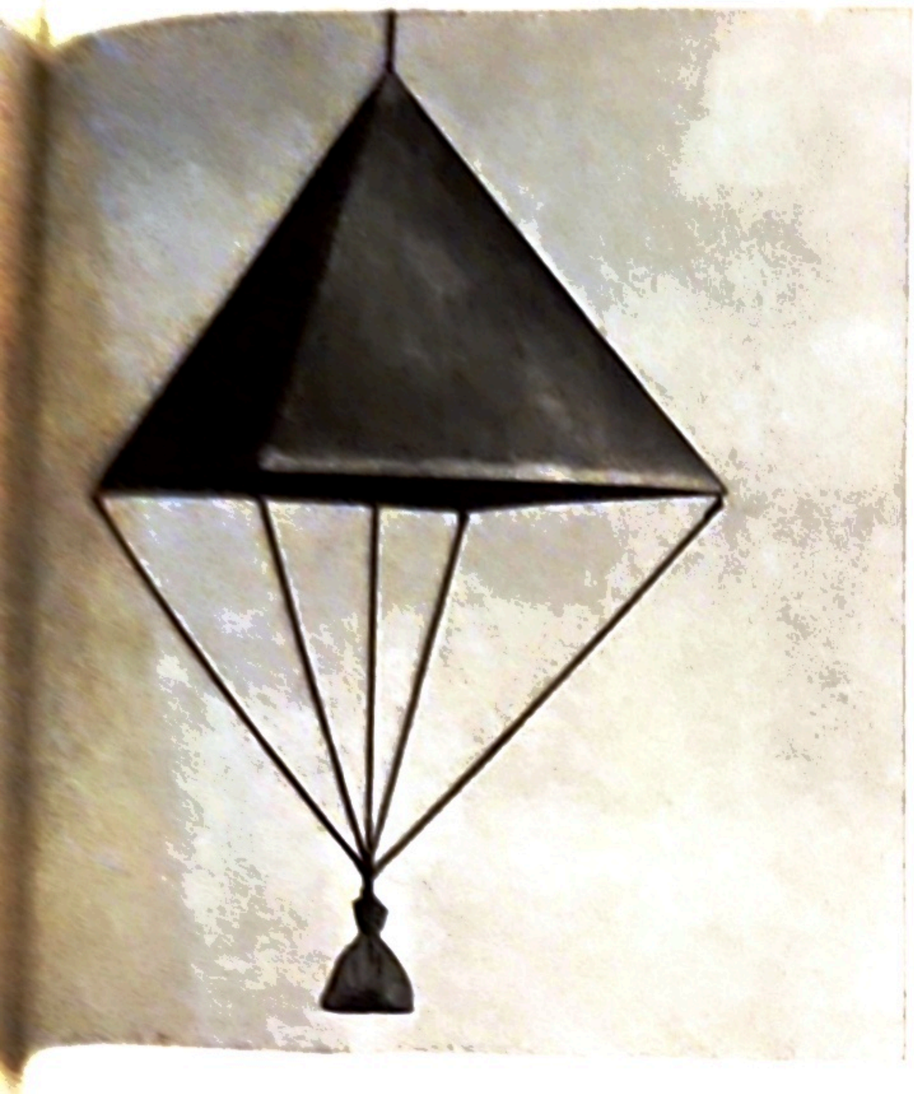
The first thing he did after he had been in Milan for only a short while was to return to Florence. For six months he lived with Rustici, a sculptor whom he advised on the bronzework for the Baptistery, his last sculptural work. Rustici was a charming eccentric who arranged fantastic parties for artists, when the dining room was transformed into a copper cauldron — he had founded a 'cauldron' brotherhood, or club — with a tree planted in the room on whose branches the dishes were laid. In this grotesque, theatrical atmosphere Leonardo set about arranging the papers he had brought with him. He noted:

Studies of hands. Silver-point drawing of Leonardo's

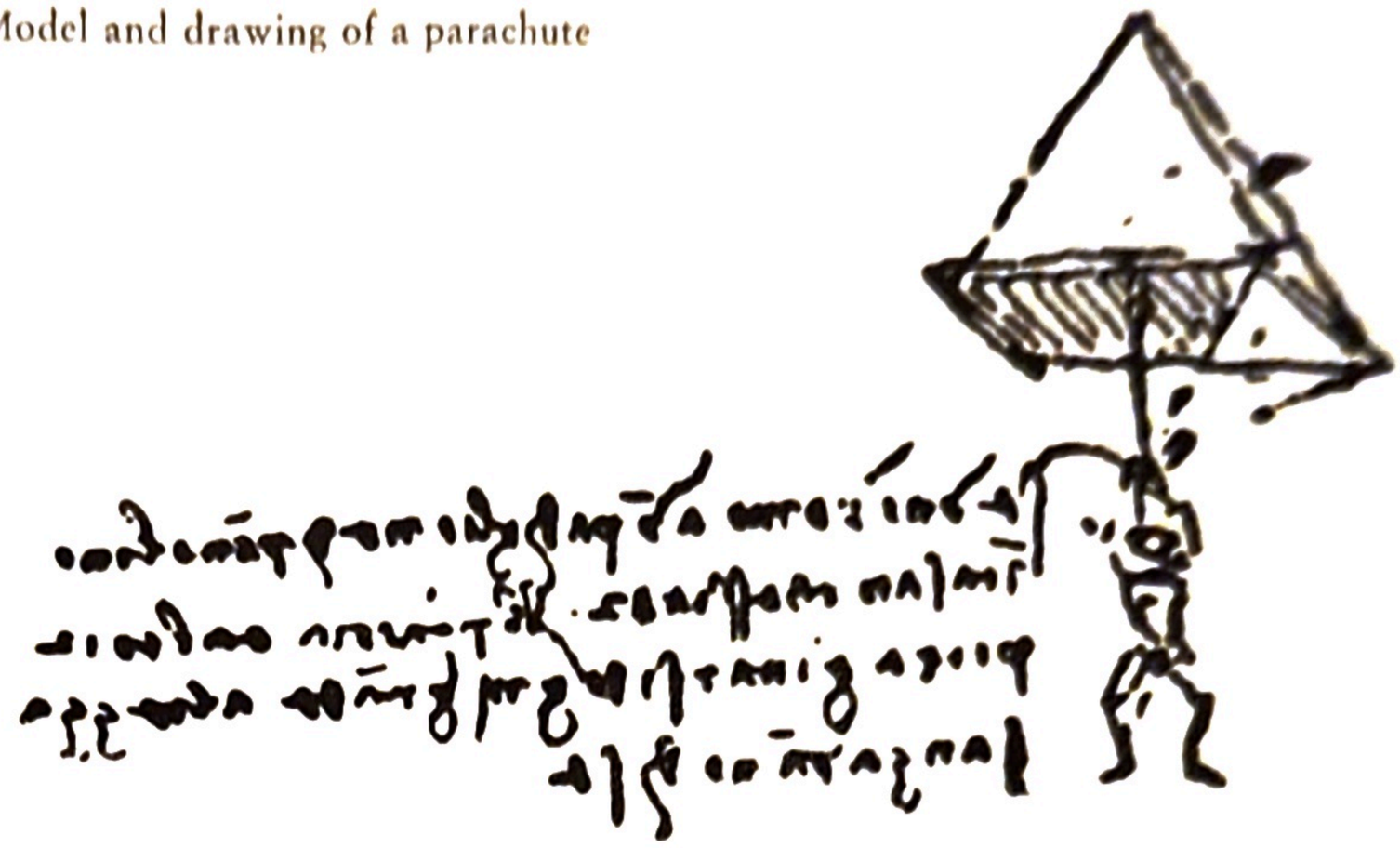
A 'nude Mona Lisa' – one example of the many imitations that Leonardo's masterpiece gave rise to

Bronze figures on the Baptistery in
Florence, in the making of which
Rustici had the collaboration of Leonardo

The Baptistery
in Florence



Model and drawing of a parachute



that he actually flew, but which in fact indicate nothing more than a dream, a poetic fantasy: 'The great bird will begin its flight from the back of the great swan [the Swan Hill near Florence] and its fame will go out into the whole world.'

In Florence and the surrounding area stories are said to have circulated about the 'great bird' which flew up from the Monte Ceceri (Swan Hill) and disappeared before it had been clearly seen.

During this second stay in Florence, Leonardo completed two paintings, *The Battle of Anghiari* and the portrait of *Mona Lisa*, besides carrying out his scientific experiments. The mural was destined for the great chamber of the town hall; a similar invitation was also given to the 29-year-old Michelangelo, who had recently been hailed as a budding genius by his fellow citizens on the strength of his statue of David. It was, in a sense, a contest between two great minds. Leonardo chose as his theme a cavalry battle with the struggle for the standard of one of the armies as the dramatic central point. Michelangelo decided to paint a group of soldiers surprised while bathing, an episode from the wars with Pisa. Both artists completed the cartoons for the pictures, and while they remained intact they were, Vasari writes, 'one of the wonders of the world'. But the execution of the murals was a failure. Michelangelo's creation was still incomplete when he went to Rome, and Leonardo's carried the germ of its destruction within itself. He had experimented with a new priming which he meant to dry off with a coal-fire. When he tried out the process in miniature it succeeded but on the high wall of the hall the heat reached only half-way up the painting and the colours of the upper section began to run. Leonardo abandoned the work which was later removed and replaced by a boringly respectable composition by Vasari.

The middle portion of the no longer extant *Battle of Anghiari* in an engraving based by G. Edelink on a sketch by Rubens

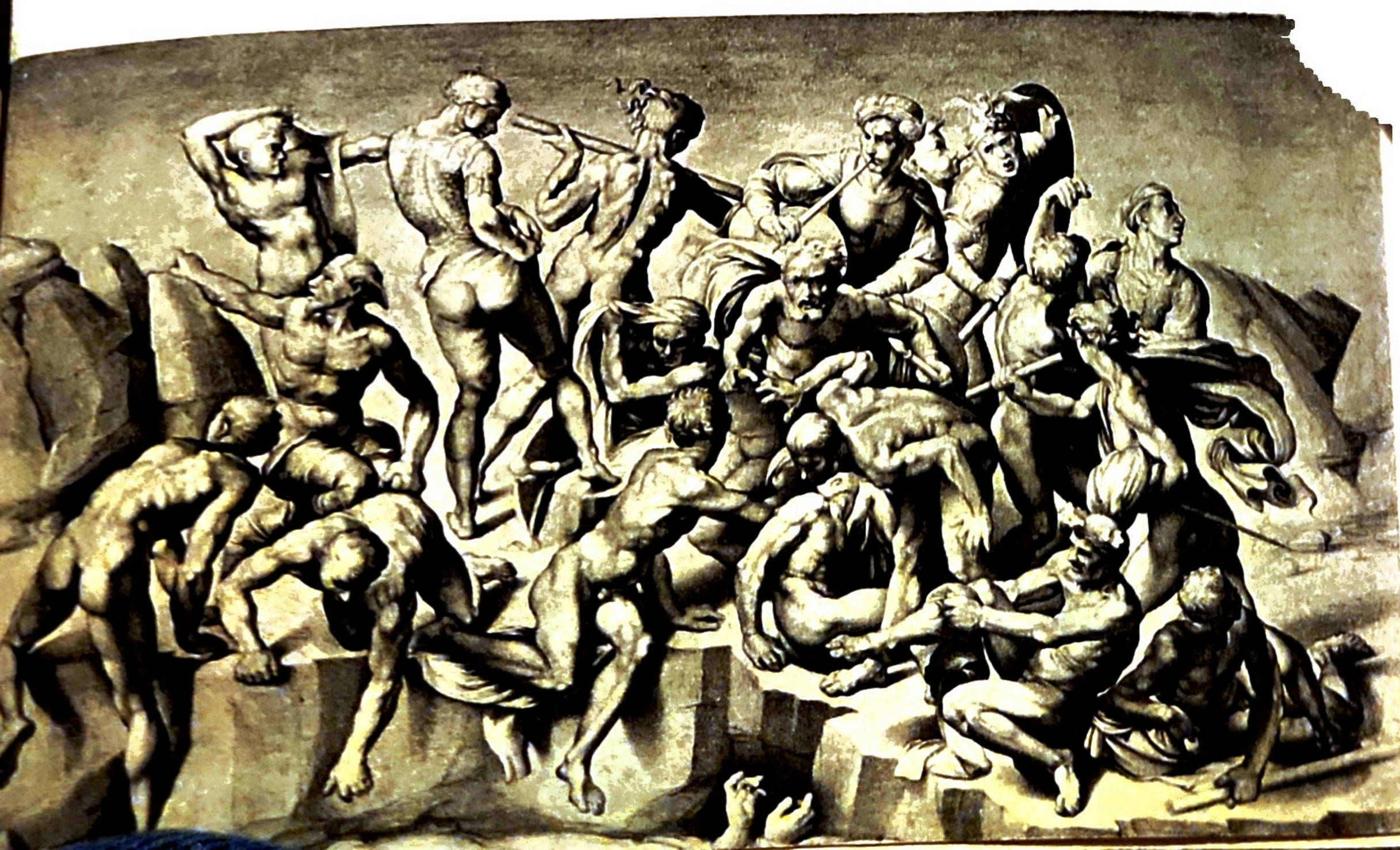
Soldiers Bathing, after a cartoon of Michelangelo's which he made by way of a competitive design to Leonardo's *Battle of Anghiari*

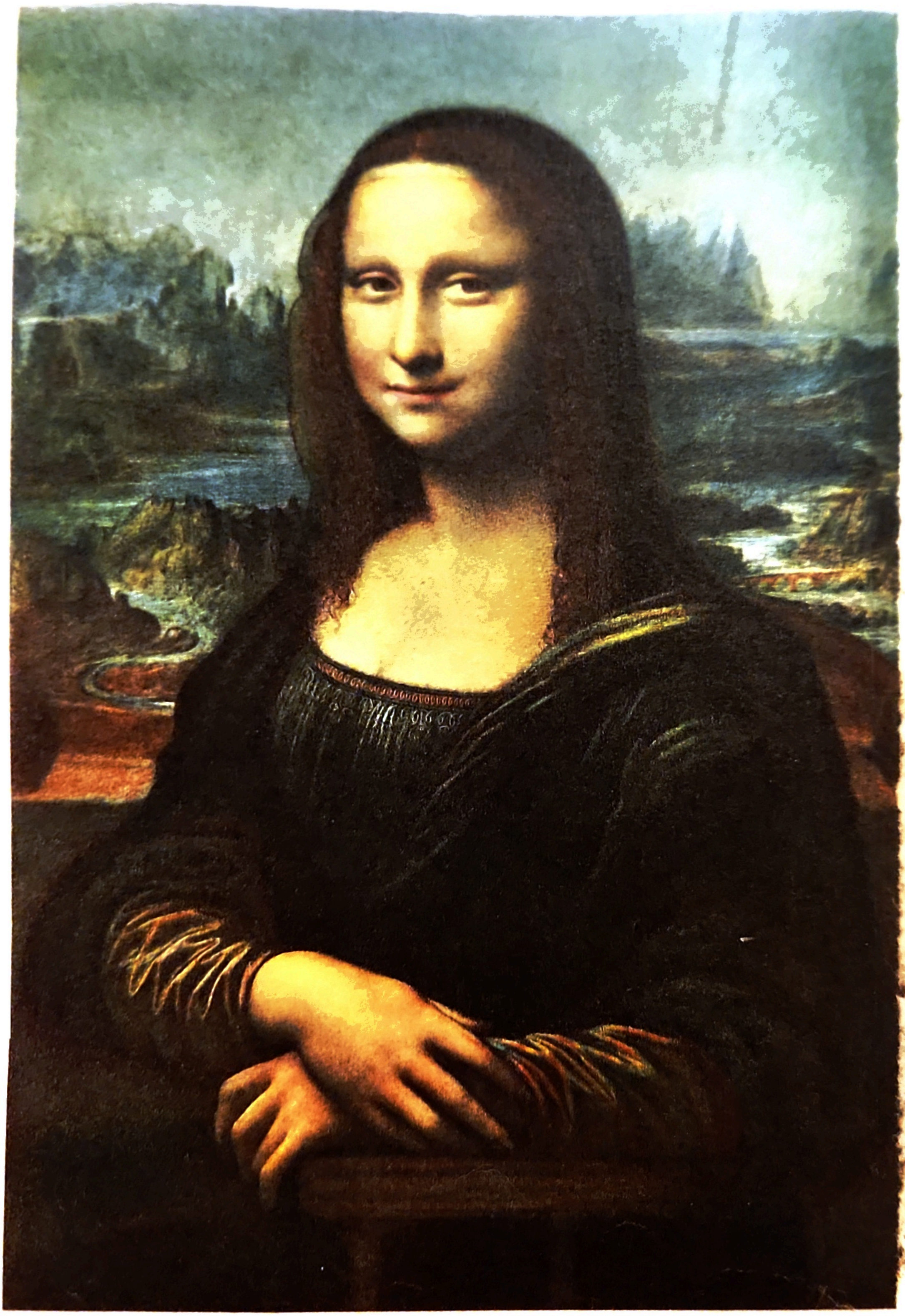
The two rival cartoons made a deep impression on the artists' contemporaries. The young Raphael interrupted the work he had begun in Siena in order first to study these new departures in art. Their details, poses, motifs were copied again and again and the discussion as to whether Leonardo or Michelangelo was the greater painter continued indefinitely. Indeed one of Leonardo's pupils Bandinelli went so far as to cut up Michelangelo's cartoon out of jealousy for his master's reputation. Leonardo's work survives in a series of copies and a fine drawing by Rubens.

The 'Mona Lisa'

The *Mona Lisa* is one of the few works by Leonardo which was completed and the only existing portrait which was certainly painted by his hand alone; it passed into the possession of the French royal house during Leonardo's lifetime and is still in the Louvre. Not that its history is entirely without incident. It was cut by about 10 centimetres on each side; it has been stolen from the Louvre: a certain Vinzenzo Perruggia, a small, insignificant Italian picture-varnisher, walked into the great museum one day in August 1911, wearing workman's overalls, quietly took down the picture and strode out. For two years he kept it hidden in the attic of his house in Paris while the newspapers of the world united in lamentation. In 1913 he took the picture to Florence in a box containing clothes and tools, offered it to a dealer and was arrested; at the trial he explained that he had only wanted to bring the masterpiece back to its rightful home. He received seven months imprisonment and the painting was handed over to the French government with great state celebrations.

This portrait has become the most described, hymned and studied in all art-history; novels and short stories have been written about it — it has even



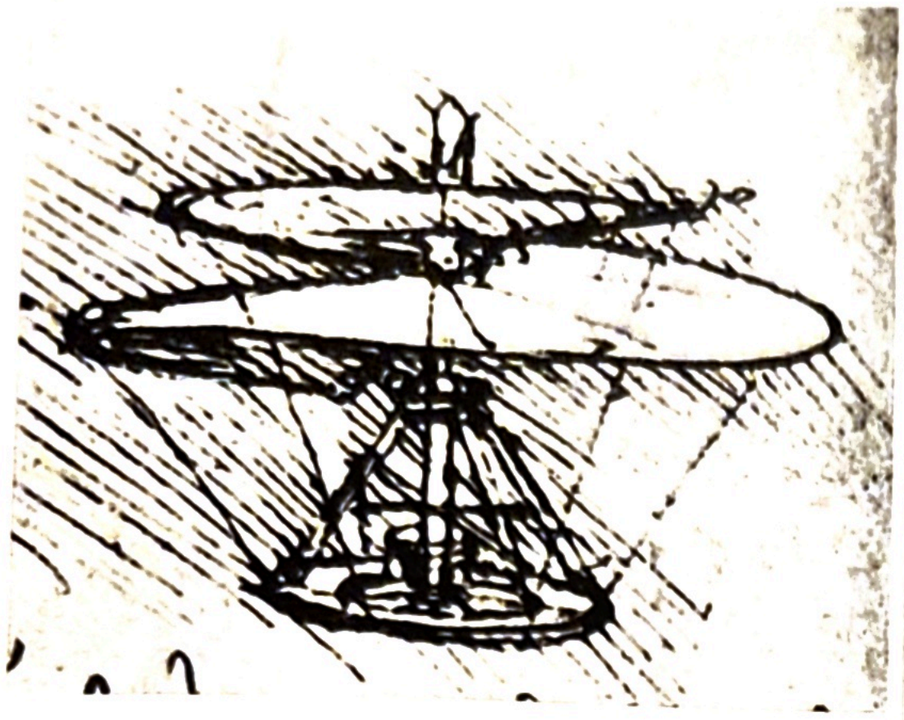


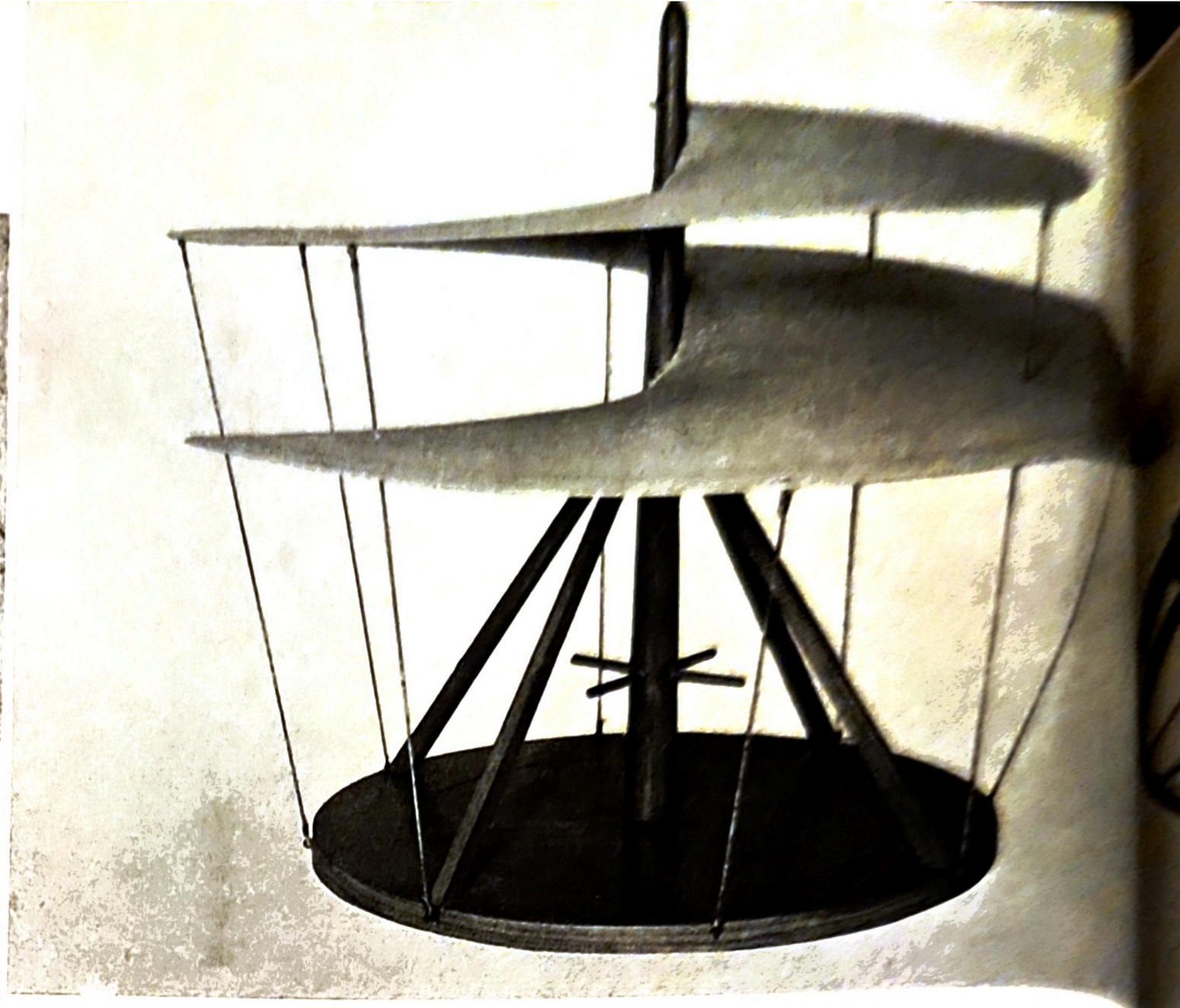
Lucrezia Borgia

Cesare Borgia

Florence. A ring of fortifications was set up round Pisa, to block provisions from the sea and the lower Arno. There had been suggestions of diverting the river. Leonardo worked out a new plan to build a canal to cross the hills, rising in steps upstream. He suggested tunnels, designed new dredgers, cranes, treadmills. However, the workers still used sixteenth-century methods of digging. Autumn storms shook the walls of the earthworks. The building operations were given up and Pisa did not fall until five years later after the Florentines had had the sea banks cut off by the pirate Bardella. But the cranes and lever-apparatus suggested a new project to Leonardo: he planned to lift the Baptistery at Florence with hydraulic winches and place it on a higher base which would rest on colonnades.

As though in extension of Cesare Borgia's high-flying dreams of conquests on this earth, Leonardo contemplated realising the ancient dream of mankind of raising himself above the earth. None of his other ideas had to wait so long — until our own times — before being transformed into reality. Correspondingly none of his inventions — often only musing soliloquies, an affair of 'one could . . .' or 'take so and so . . .' as if one had only to assume the object's existence and it existed — has made such a profound impression on the people of our own time, as these drawings and calculations about flying-machines. Whether Leonardo actually made models of such machines is not known, although it is probable. He certainly never flew; he raised himself above this earth only in spirit. Other men of the period also dealt with the same problems; a not altogether reliable account states that the mathematician Giovanni



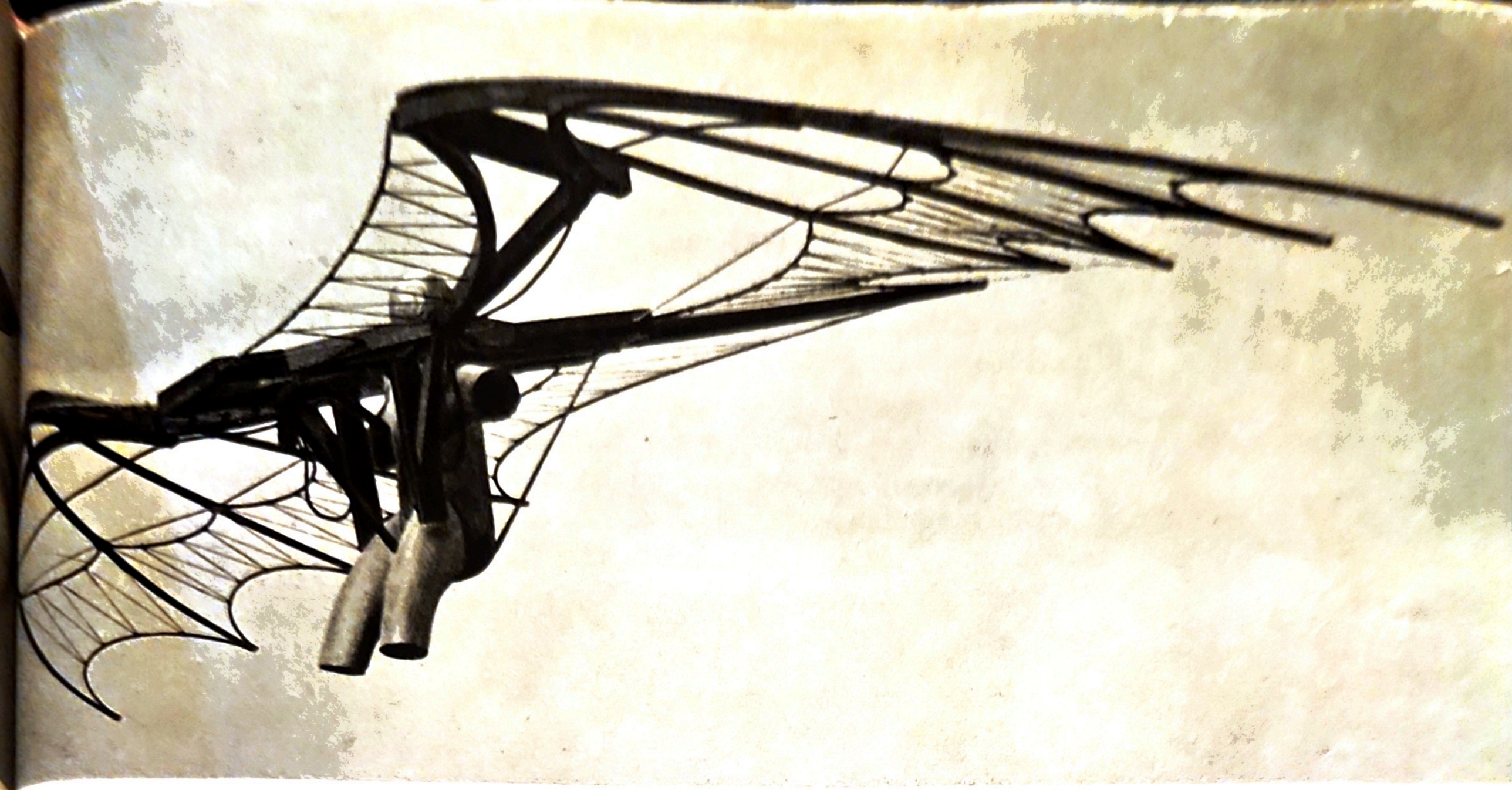


Design for an air-screw with, next to it, the model fashioned after Leonardo's drawing

Battista Danti flew over Lake Trasimene, and a better supported story reports that he jumped from the church tower in Perugia and made a small gliding flight by means of a parachute, breaking a leg and thereafter giving up his attempts.

Leonardo designed an air gyroscope with the rim made of iron wire and the surfaces covered with linen 'the web of which is made air-tight with starch', and stiffened with thin reeds. He experimented with two rulers, one broad, one narrow, 'whirled most rapidly through the air, so that you will find your arm born in the same direction and along the same axis as the plane of the ruler'. He writes of a 'small model made of paper' that it would be possible to construct. He also designed a square parachute and wrote confidently. 'With a tent made of material 12 ells long and wide, a man can jump from any height he likes.'

But the project nearest his heart, his private Icarus-dream, was flight with large flapping wings, bird-flight for man, in fact. While still in Milan, he had made preparatory studies, observed air resistance and noted down as a scientific law: 'In using this object one exerts as much pressure against the air as the air does against the object.' He goes on: 'You see that the wings when flapped against the air have the effect of enabling the heavy eagle to support himself in the highest, thinnest atmosphere. Moreover you see that the air moving over the sea



Model from one of Leonardo's designs for an aeroplane

makes even a heavily laden ship move more quickly when it presses against the sails.' He adds triumphantly: 'From this self-evident reasoning you can see that Man will be able to subdue the air and raise himself above it if he can exert a certain force against the resistance offered by the air with his large artificial wings.' For the construction of these 'huge flapping wings' he studied the anatomy of the bird's wing. In a notebook dating from his Florentine days he sketched what he had observed and planned a treatise in four parts *On Birds*. He made innumerable attempts to calculate human strength, the only motor energy at his disposal. He believed he could get a force, generated by the hands and feet, capable of lifting 850 lbs., and he added compression-springs and invented his own tension-mechanism for the machine. He drew many different kinds and shapes of wings, both single and double-decker. With his usual concern for the most minute detail he thought of accessories and added conveniences — a ladder with which to climb into the apparatus, a sort of shock-absorber to make the landing smoother. The covering fabric was to be of taffeta strengthened with gum and made even more reliable by a net-like covering of narrow meshwork. He invented ever more complicated ways of generating power by means of sets of pulleys and stirrups, ways of raising and lowering a vertical axle with a screwthread, axle-shafts powered by winches, a wheel to be driven by two men. Moreover, his notebook, reflecting

what was going on in his mind during this flood of invention, not only contains commentaries on birds' flight, on the construction of human joints and drawings of diagrams. He also philosophises, stating: 'Mechanics is a very noble science and useful above all others, for it describes the way in which all living creatures move.' On the last page, which is a sort of cross-section of his compendious mind with its explorations in all directions, are a drawing of running water, an idea for a dam, cog-wheel screws, a device for transplanting tall trees and a series of diary entries: '1505, Wednesday 14th April, Lorenzo came to live with me and he was 17 years old, he said. And on the 15th of the same month I drew 25 gold guilders from the chamberlain of Santa Maria Novella.' And immediately afterwards come the lines which have been taken to indicate

Legend has it that attempts
to fly were made in Leonardo's
day on Monte Ceceri,
the 'Swan Hill' near Florence

The burning at the stake of Savanarola
in the Piazza della Signoria
in Florence on 23rd May 1498.
A picture by an unknown 16th-century
Florentine master

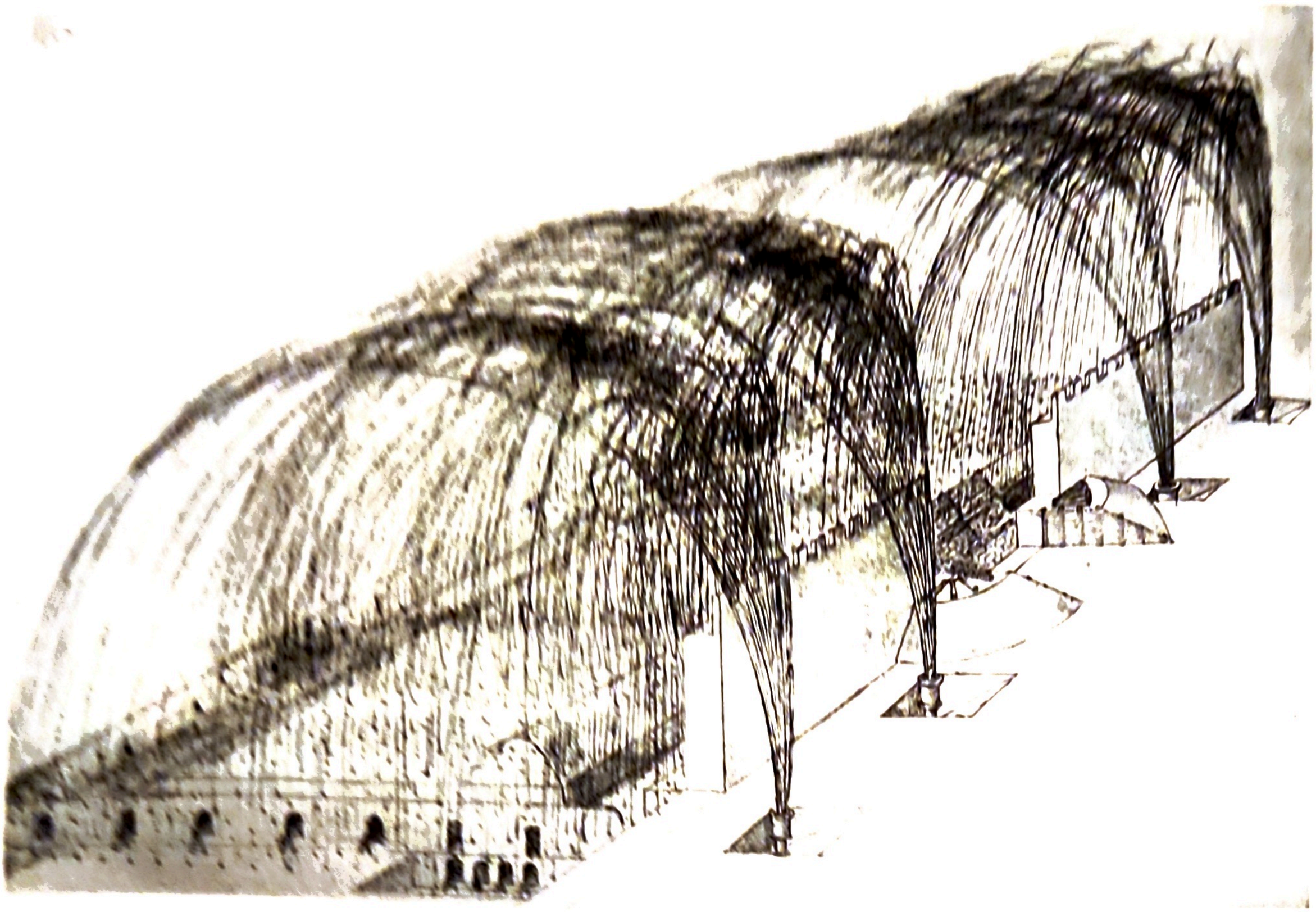
The Virgin and Child with St Anne
An unfinished oil painting,
which Leonardo took with
him to France from Milan

Isabella d'Este, Leonardo's
tireless supporter.
After one of his drawings

With Cesare Borgia

possession of the Romagna and Urbino, murdered the second husband of his sister Lucrezia, had the prince of Faenza liquidated by his bravos; he was planning now to march on Florence and North Italy. Leonardo entered his service as a military engineer; the pass which Cesare issued him described him as 'our extraordinary and beloved servant the architect and chief engineer Leonardo Vinci'. Without hesitation he plunged straight into the work, drew maps of the area round Florence with amazing delicacy and clarity, carried out a survey, noted the lengths of roads, planned new multiple cannons and other engines of war and yet found time to inform the Sultan of Turkey, through a delegation then waiting on Cesare Borgia, of a project for a bridge over the Golden Horn: '40 ells wide, 70 ells above sea-level, 600 ells long, of which 400 ells are over water and 200 over land; in this way it supports itself.'

He left the Borgia's camp without delay when the usurper's own commanding officers rebelled, the poison destined for the counter-conspirators carried off the Pope, and Cesare himself fell ill. He went back to Florence, which needed his services for its war against Pisa, the rival city on the Arno which was allied with Borgia. Cesare's adviser became the adviser of the Republic of

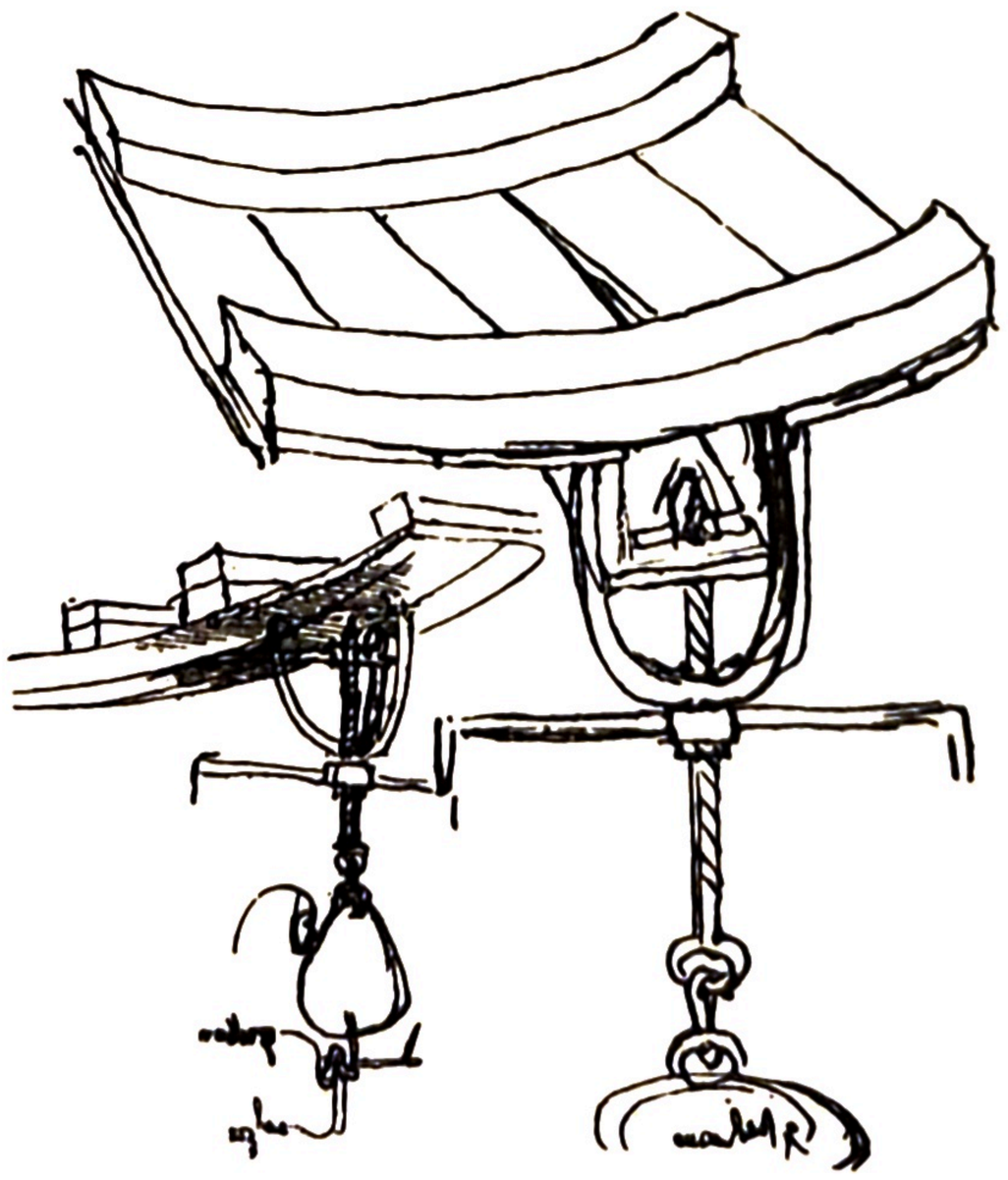


'Rain of shot' – a kind of howitzer for use in a fortress

One of Leonardo's maps of Tuscany, which he drew for Cesare Borgia

All our admiration for Leonardo's amazing ideas, often so many centuries ahead of their time, should not blind us to the fact that he himself lacked perhaps the most important element in the successful inventor's make-up: the stubborn perseverence which enables him to pursue an idea, often a single idea, sometimes even an *idée fixe*, to its furthest limits. Leonardo had not one idea but thousands. He wrote not one book but, as he says above, a hundred and twenty — or rather he began 120 books which he did not finish. He scattered his thoughts like broadcast seed and it was some time before they took root and grew. Also it is impossible to distinguish how many of his ideas, designs, discoveries and inventions were adopted by others. Even with all his precautions and secrecy much must have filtered through. Again, much was the common property of the age; he was not the only person to design or dream of paddleboats, flying machines, diving apparatus and lever-gear. Historians of science are only today beginning to disentangle the puzzling web of ideas and inventions of the period.

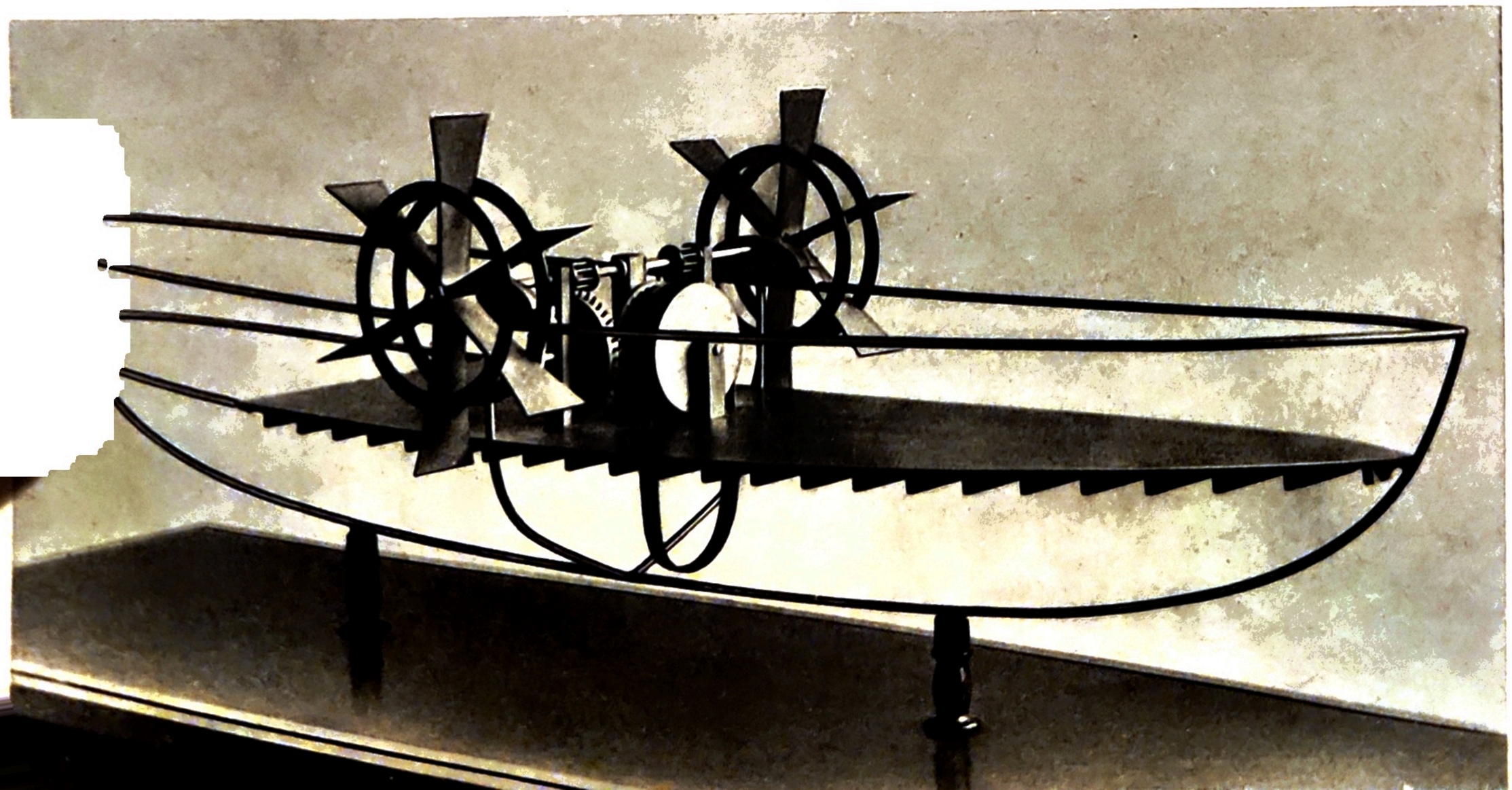
Even with these reservations there is sufficient to admire in Leonardo's one hundred and twenty notebooks. There is no one to compare with him in the beauty of his designs, and in his grasp of the essentials of a subject, however little he was able to persevere with it and bring it to triumphant fruition. Attempts have been made to build models from some of his designs, but when made concrete they lose much of their fascination. To our eyes they seem rather prosaic, very like objects we know only too well — a diving suit not much different from those of today except that the helmet is of leather instead

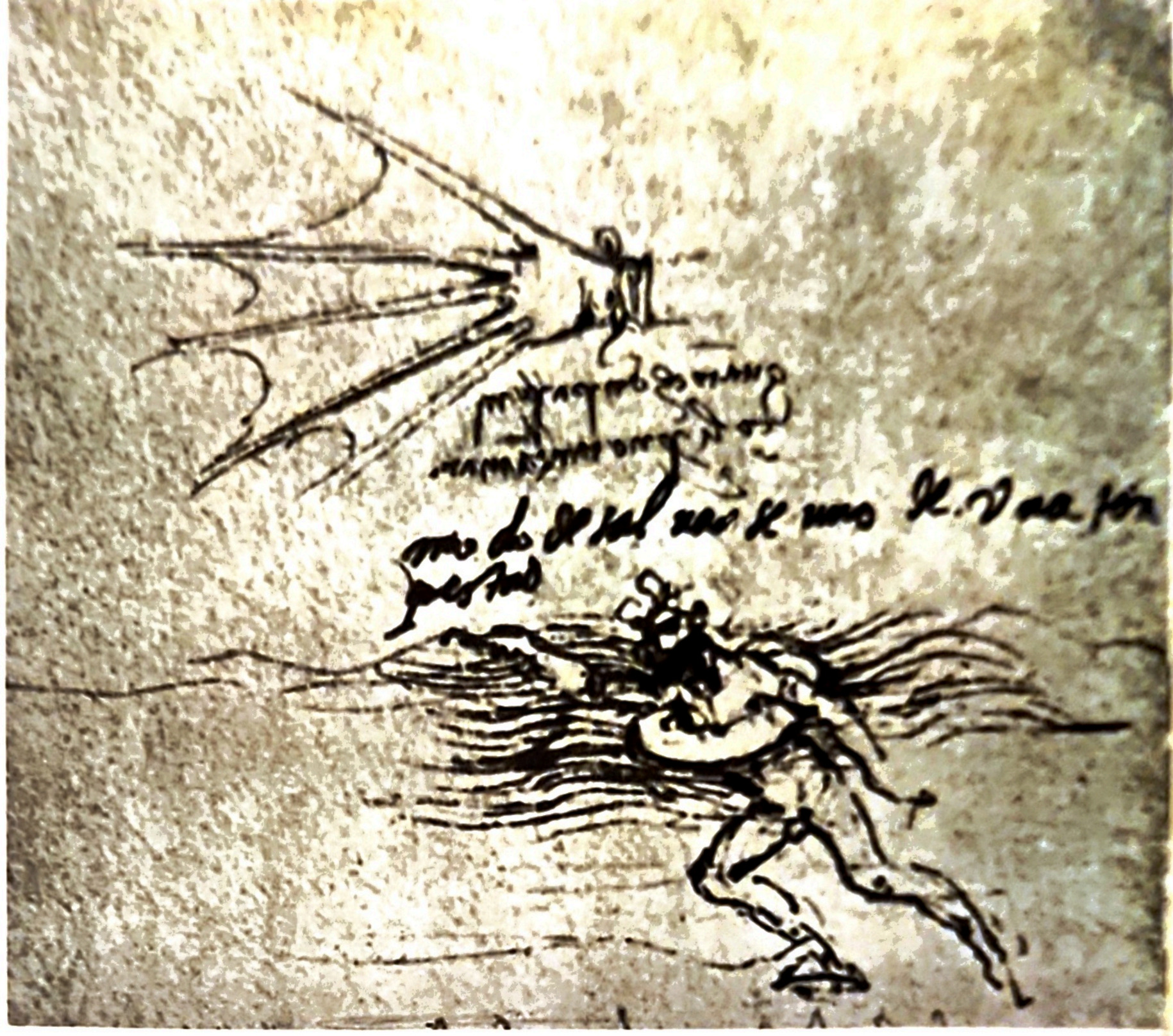


Arrangement whereby divers could bore holes in a ship's hull under water

Supper in the new, monumentally simple style, had retired to a monastery and given up painting many years ago. The Dominican Savonarola had changed Lorenzo's Florence into a town of contemplation, repentance, and rejection of all secular magnificence, with his dictum: 'Down, down with all gold and decorations, down where the body is food for the worms.' He had ordered the children of the town to build a great pyre in the market place and burn all the playing cards, dice, musical instruments, pictures and books (including those by Boccaccio). He had initiated a new, strictly disciplined regime which soon became oppressive; the town split into two parties, he attacked the Pope and was excommunicated. The divine judgment was to be sought by means of a trial by fire; it ended in a savage uprising of the popular party, the Popolari, and the Arrabiati, his opponents from the signoria. On 23rd May 1498 Savonarola was burnt as a heretic in the square in front of the Palazzo Vecchio.

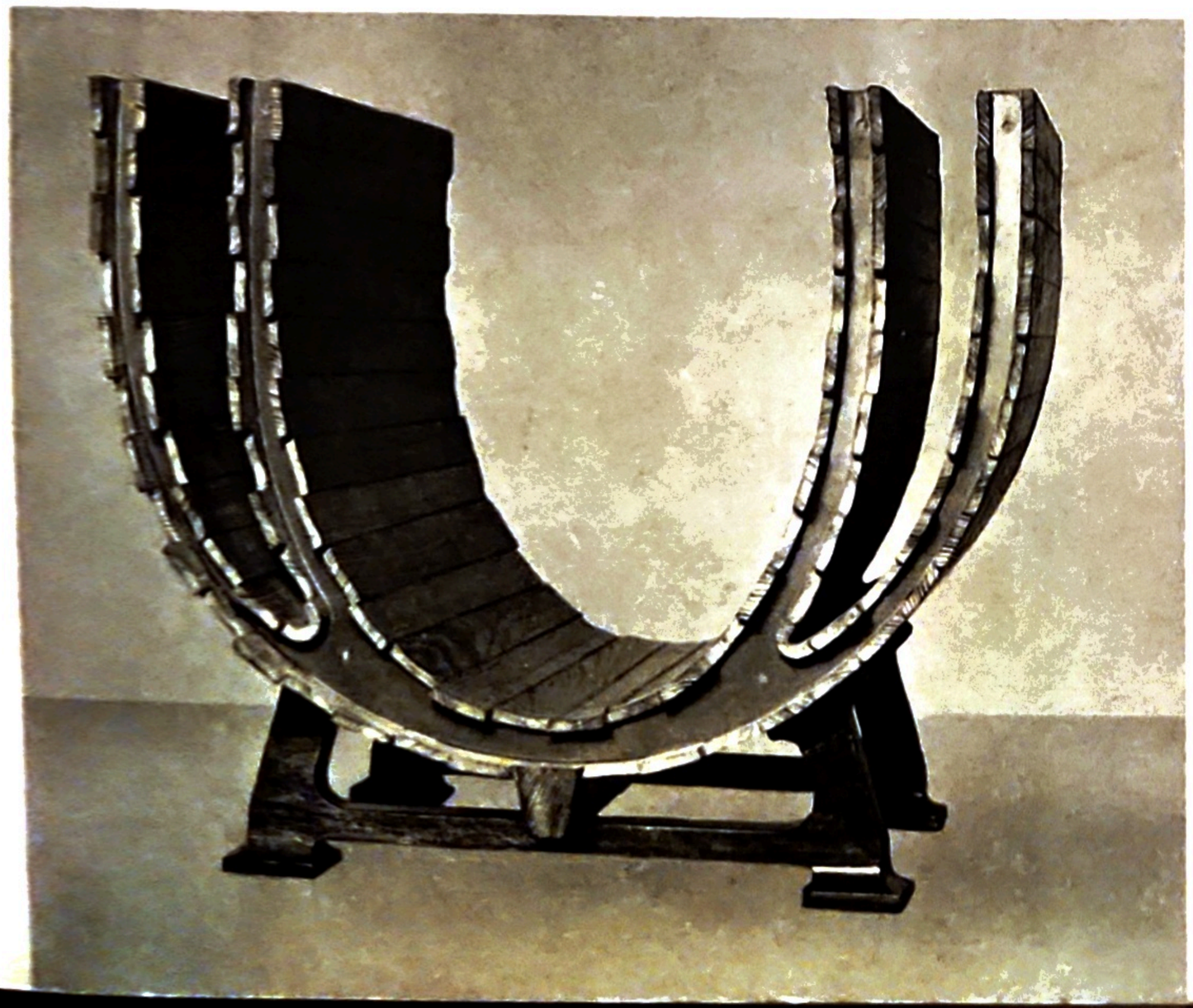
The town to which Leonardo returned was enveloped in a certain gloom. And it is curious that his life and work at this period were also uncertain, hovering between geometric studies and a new commission for a large painting. The monks of the Servite monastery had ordered an altarpiece from Filippino Lippi, but he modestly withdrew when he heard that Leonardo was prepared to paint the picture. 'The monks,' writes Vasari, 'took Leonardo into their house so that he could accomplish the work. They bore the expense of his lodging and that of his companions and he did not even begin on the work. But finally he drew a cartoon for it, in which were portrayed the Virgin, St Anne and Christ. And this drawing not only filled all the artists with admiration; when it was finished and exhibited, men and women of all kinds, young and old, thronged to the room as though they were taking part in a sacred ceremony, and everybody was amazed at its splendour.'





A fin
and lifebuoy
in a sketch
of Leonardo's

It was not until later that Leonardo again took up the theme of the *Virgin and Child with St Anne* and completed the picture with the help of his pupils. The lofty, almost classical simplicity of the figures, the fluidity of the movements leading from Anne's statuesque head over Mary, leaning forward, to the Christ child turning round in a life-like manner and finally to the uneasy looking lamb — all this and the fact that the whole is enclosed in the strictly mathematical form of a triangle, must indeed have seemed a revelation to the artists of the day. What is more surprising is the discerning art appreciation

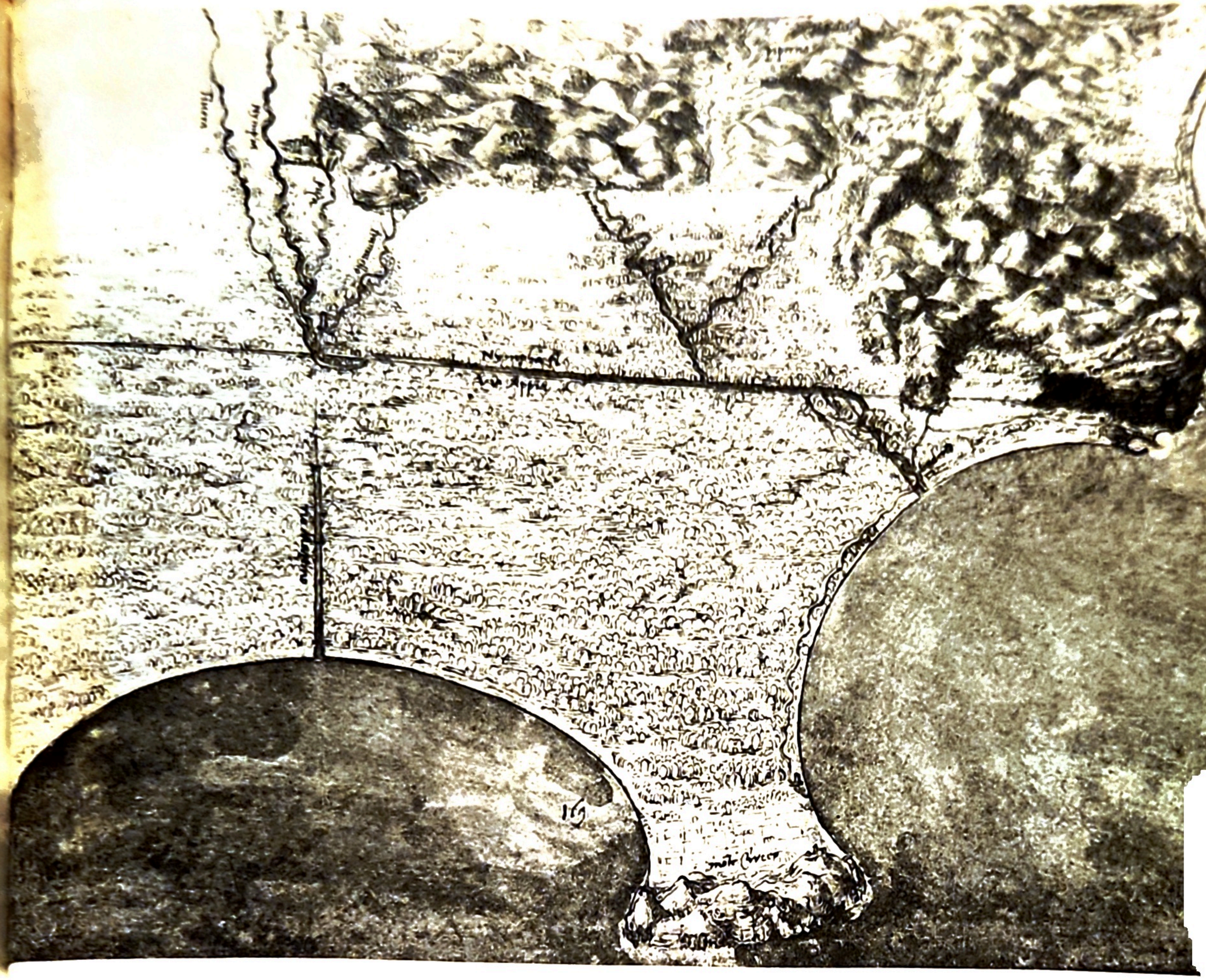


Ship with paddle-wheel
motion *(left)*,
and model of a double,
'unsinkable' ship's hull

of the common people of Florence, the fact that they too were impressed by the total effect of a picture which was so different from all they had seen before and had no trace of the intimacy and confiding human warmth which had been the mark of the preceding generation.

In the end the monks gave the commission back to Filippino Lippi. Isabella d'Este who again sent her agents in Florence to ask Leonardo for works by his hand, also received disappointing reports: 'At the moment he is interested only in geometry,' or: 'Leonardo's life, as far as I can see, is complicated and wholly unpredictable; it seems as though he lives from hand to mouth.' The 'unpredictable' Leonardo fled from the monastery to the camp of Cesare Borgia, the son of Pope Alexander VI (the 'Borgia' Pope) who was planning a campaign to gain the rulership of Italy. 'Only his illness and Alexander's swift death,' Machiavelli wrote, 'prevented him carrying out his plans. A usurper whose aim is to make certain of both his friends and his enemies, to become great through power and cunning, to gain the fear and love of his people, the respect and obedience of his soldiers, to get rid of anyone who could endanger him, or to institute new state policies, could take no more fitting model.' Cesare removed the leaders of the Roman nobility and royalty, gained

Florentine citizens
of the 15th century



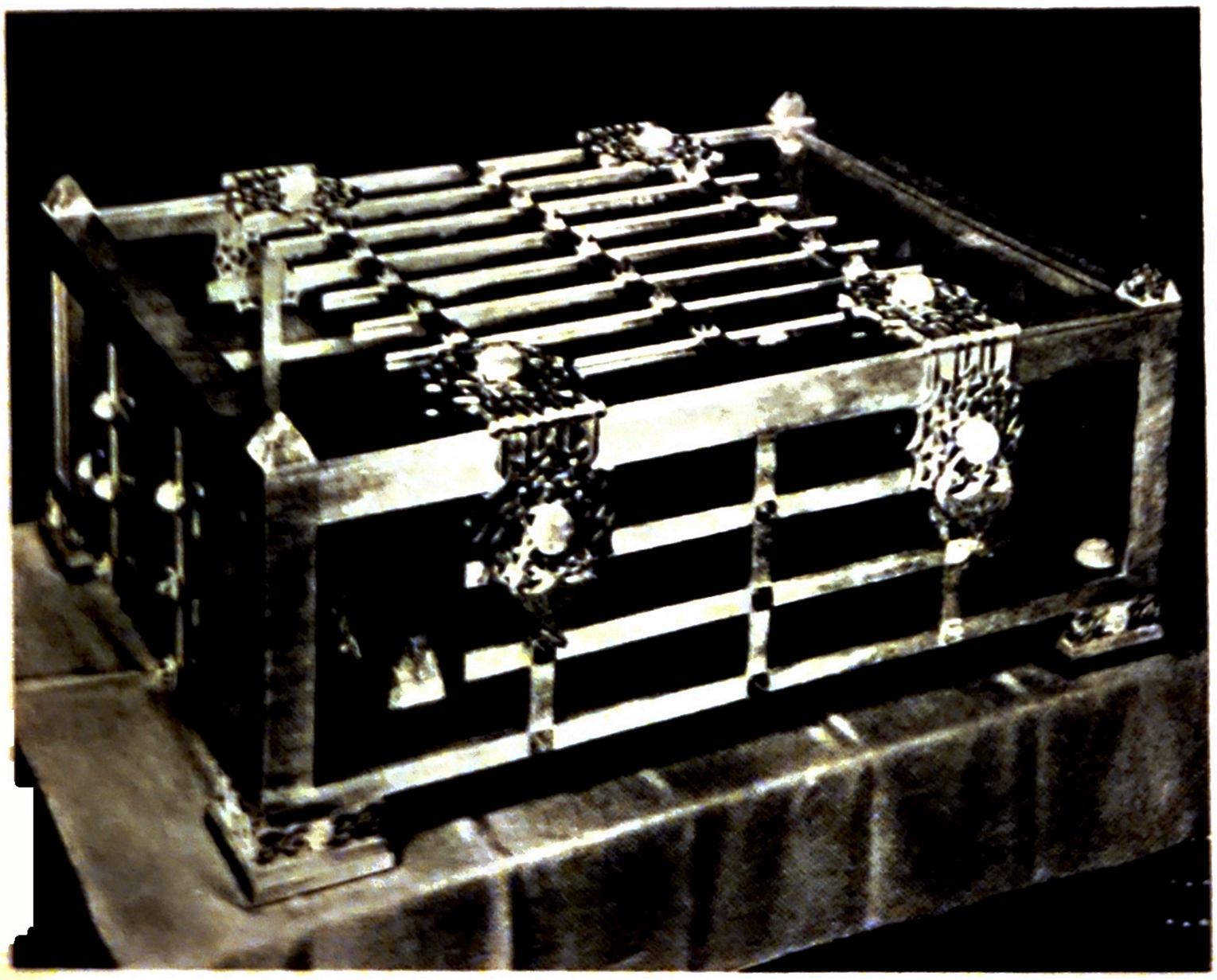
standing, supported by his friends and servants'. He is said to have died in the arms of the king after confessing to him 'how he had failed in his dealings with both God and man and that he had not even done his duty as an artist'. But in fact François I was not in Amboise on the day of his death. And an outburst of repentance such as Vasari describes seems strangely at variance with Leonardo's usual character, although it is possible that on the point of death he sought to make his peace with the Church.

His real legacy was his written work, which Melzi brought back with him to Milan where the largest of the volumes later put together, the *Codex Atlanticus*, still remains, preserved in a costly case of rock-crystal. When, in his notes, Leonardo speaks of death and the next life it is with philosophic resignation

and rather in the spirit of the sage as whom Raphael portrayed him in *The School of Athens:*

'See: one's hopes and wishes to return to one's homeland and origin — they are just as moths trying to reach the light. And the man who is looking forward with joyful curiosity for the new spring, and the new summer, and always new months and new years — and even if the time he is longing for ever comes, it will always seem to him to be too late — he does not notice that his longing carries in it the germs of his own death.

But this longing is the quintessence, the spirit of the elements, which through the soul is enclosed in the human body and which craves for return to its source. You must know that this very yearning is the quintessence of life, the handmaid of Nature, and that Man is a model of the world.'



In this shrine lies Leonardo's
greatest legacy to posterity;
the *Codex Atlanticus,*
with his drawings and sketches,
which Pompeo Leoni collected

Acknowledgements

The figure of Leonardo da Vinci is shrouded in greater mystery than that of any other great artist and thinker. The shadowy side of his life predominates; his pictures too, insofar as they have survived, have grown shadowy. Most of what he wrought was soon destroyed or was spoiled, often already during his lifetime. His œuvre is therefore a subject of controversy. Latter-day research, often with appreciable divergence of views, has designated pictures as 'from Leonardo's workshop', as 'of the school of the Master' or as 'having been produced under his influence'. It has also attributed works wholly or partially to him, whilst individual experts have not infrequently changed their minds and revoked their earlier opinions. We may here point out, however, that the very extent of this literature, which comprises several hundred volumes and some thousands of essays, is an earnest of the greatness of Leonardo.

Still extant, however, by strokes of good fortune, is the priceless fund of drawings, sketch books, plans, diaries and so forth, which is richer than that of any other artist of his day. Even of this material much has been lost or has been torn apart. The greatest collection, the Codex Atlanticus, is in Milan. Another substantial portion came to England, and is now in the Royal Library at Windsor. Other manuscripts again were carried off from Milan by Napoleon and have been in Paris since. Single sheets have been stolen, and occasionally some turn up again. The sifting of these 7000-odd sheets and their re-assortment in their original context will provide work for generations to come. There are sumptuous volumes devoted to facsimile reproductions of this material, arranged according to its present location. Not only art historians but specialists in all the sciences have studied Leonardo and his work in the light of these drawings and writings. Leonardo the technician, the anatomist, the geologist, the inventor, the philosopher, the observer of optical phenomena, the botanist, has been the object of investigations and interpretations. Many nations have made their contribution. As early as 1651 his treatise on painting was printed in Paris, a Russian was the first to publish the notes on the flight of birds, an Italian publisher the 'Codex Atlanticus', whilst the Academy in Rome and Christiania (Oslo) University issued exemplary compilations.

We are indebted to the following for their kind co-operation: the Royal Librarian at Windsor Castle, the Director and Trustees of the British Museum, the Directors of the Courtauld Institute, of the Museo della Scienza e della Tecnica, Milan, of the Library of the Deutsches Museum, Munich, and of the Elmer Belt Library of Vinciana in Los Angeles.

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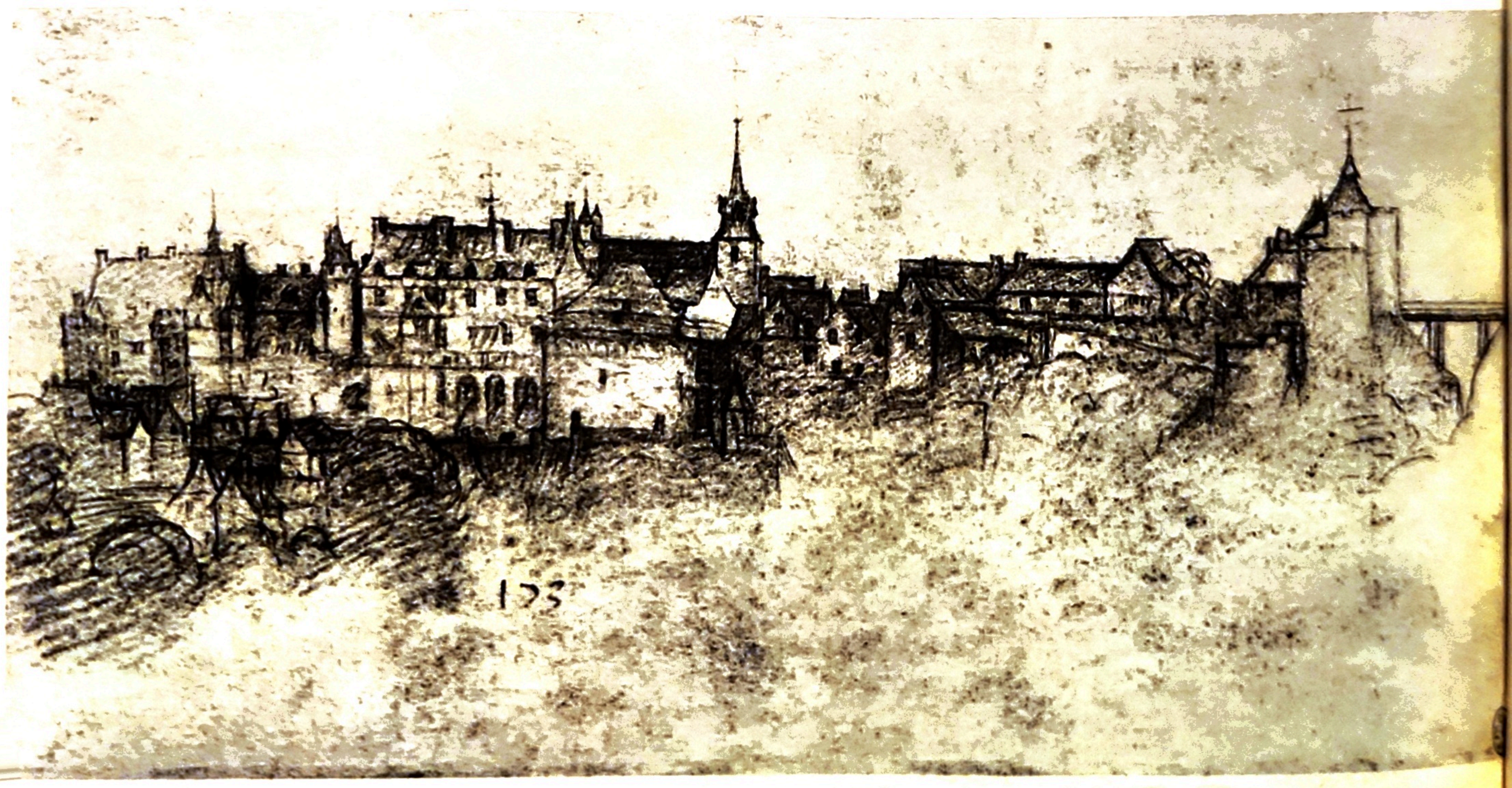
Tree. Pen drawing on white chalk

streets: 'The houses should be altered and arranged in an orderly fashion, which can easily be accomplished.' Operations which took several centuries to achieve always struck him as easy. He had, at this time, one idea which has only been perfected in the twentieth century — prefabricated houses. And like the dying Faust returning to the ideas of his youth, he turned once again to canals, maps, sluices, mills, working with his left hand which he had always been able to use; it was fortunate that the right, which was paralysed, was not essential to him. His only companion was Melzi from Milan, of good family,

Francis I of France,
Leonardo's last patron.
After a painting by F. Clouet

The view of Amboise
in a drawing of Leonardo's.
Here he spent the last years
of his life. The 'Clos-Lucé',
Cloux Castle near Amboise, was his
residence, where he died 2nd May 1519



well-to-do, a poor painter but a tireless admirer of Leonardo; Salai, his servant of 25 years, had chosen to remain in Milan and build a house on Leonardo's estate. It is due to Melzi that Leonardo's œuvre remained intact. Visitors heard of the treasures he had brought with him, the *Mona Lisa*, the *John the Baptist*, the *Virgin and Child with St Anne*, the manuscripts, the anatomy above all, 'a work such as has never before been undertaken by any man', as a contemporary account says. Leonardo became a sight, his house a museum. As at the Court of the Sforzas, he once more helped to make charming mechanical decorations for Court festivities. Lorenzo de Medizi, the younger, was celebrating his marriage to a niece of François I. The tourneys and banquets lasted four weeks. There was a cannonade of wooden guns shooting cannonballs, a model of the heavens set up in the palace and illuminated in the evening; it is as though in this masquerade Leonardo's early ideas were reborn.

He liked to take his rest sitting in front of his house, as he is shown in a late drawing, looking out on to the moors that he wanted to drain and the rivers he wanted to canalise. In the winter of 1518/19 he fell ill again. He summoned a lawyer and made his will, bequeathing books, manuscripts, instruments and drawings to Francesco Melzi. We see from the document that he had a serving-woman, to whom he left 'a dress of good, black stuff, trimmed with fur, a coif and two ducats, as a final gift', and a manservant to whom he gave half of his vineyard, the other half going to Salai. He also remembered the

About 1514 Leonardo painted this map of the Pontine Marshes. The old canal that runs parallel to the Via Appia (middle of picture) he suggested should be used for drainage and the broad strip of land cultivated

The last self-portrait of Leonardo? This drawing of a thoughtful old man who looks out upon the landscape, has been claimed as a self-portrait of the artist

Leonardo's death

Church. He expressed a desire to be buried with a certain pomp: sixty torches were to be borne before the procession by the poor of the village, whom Melzi, as executor of the will, was to pay for their services. Leonardo finally forgave his stepbrothers and stepsisters who had bedevilled his life with lawsuits about his father's property and the legacy from his uncle Francesco. He bequeathed them his account at the monastery of Santa Maria Novella in Florence. On 2nd May 1519 he died.

Legends have grown up round his death as round every other part of his personality. Vasari tells in his biography that the master was overcome by repentance. In the months before his death, he asked for guidance on many religious questions, made confession, weeping as he did so, 'and, although he could no longer stand upon his feet, insisted on receiving the sacrament while

and want to see great contributions to their fame while they are yet living. His favourite was Raphael, who could accomplish in a short period tasks that would take others decades. Michelangelo, too, had completed the ceiling of the Sistine Chapel in four years. Leonardo was given a small task. He began by distilling herbs for a new varnish. 'Alas,' said the Pope, 'he will never complete anything. He thinks of the end before he has even begun.'

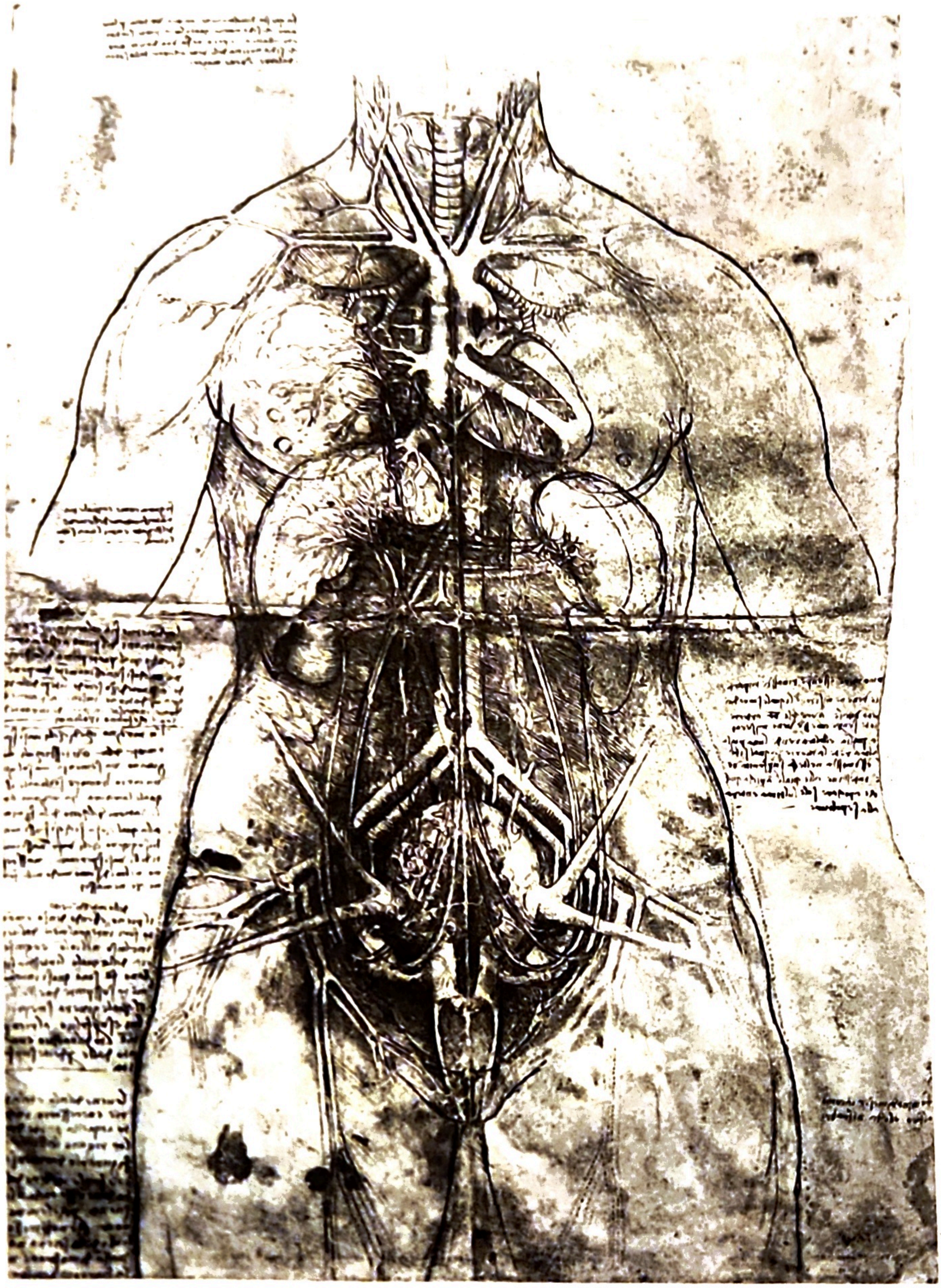
Leonardo continued with his herbs and plants. He was captivated by a new science: botany. He drew leaves and flowers, observed the growth of trees, the positioning of leaves on the branch, the rising of sap. His plant drawings reflect these studies: they are not mere pressed-flower albums but representations of the living article. They and his anatomical drawings are the finest example of his unparalleled gift for combining scientific ideas and artistic portrayal into a light, spontaneous and convincing creative work.

His health now began to fail and he was ill for the first time in his life. His

Embryo. Drawing by Leonardo, whose anatomical representations have remaind unsurpassed to the present day

Leda and the Swan, a copy based on a lost painting by Leonardo

An 'X-ray picture' of the human organs: this method of representing the human body must have been entirely novel to Leonardo's contemporaries



Bramble shoot
Chalk drawing
by Leonardo

assistants and servants neglected him; his diaries are full of bitter complaints. With grim humour he spent his time in grotesque games and plays, modelling animals of wax and then exploding them, blowing up sheep's bladders with air by means of bellows until they filled the entire room and pushed the horrified visitors into a corner.

However, there were not many visitors. He was lonely. His mind began to play with ideas of catastrophes and calamities, as though pre-figuring his own end. He drew and wrote a poetic description of a Flood: 'And the masses of rock laid bare the gnarled roots of the trees which they had cast down so that the roots were uppermost. And in the mountains, which were washed quite clean, deep rifts and crevices were revealed.' He went on to describe the

despair of man and beast — the whole is no longer a plan for a picture but a projection of his own mental state.

The death of his patron Giuliano disposed of the last reason for staying in Rome and waiting for further commissions which would not come. He left, and this time went far away, not to Florence or Milan, but abroad, to France. François I put a dwelling-place at his disposal at Amboise in Touraine. He passed three silent years there in a sort of villa with eight rooms, the little Château de Cloux, situated between the city and the royal palace. He was held in great esteem; the king visited him from time to time. Benvenuto Cellini recorded that the king told him he did not believe that any mortal had ever known as much as Leonardo. There was talk of building projects, of a hunting-lodge for the king, and, as ever, Leonardo immediately expanded the plan far beyond its original proportions. He designed new

In Amboise

World catastrophe – a visionary drawing from Leonardo's last years

– in fact the Bacchus was created by painting over an earlier John. They are timeless and almost sexless, or rather a mixture of sexes which is deeply moving. It is difficult to tell how many and what parts of these pictures were actually painted by Leonardo. His pupils took up the famous mysterious smile like a successful trademark and turned up the mouths of numerous copies and new versions of angels, girls, Christs, a Salome and a Narcissus.

Studies in anatomy

There could be no greater contrast than that between this misty grotto-world and the clarity and precision of Leonardo's anatomical studies. Ruthlessly he penetrated into regions of the body and its functions which had previously been a closed book to almost everyone. At a time when medical specialists clung almost exclusively to book-learnt knowledge and it was held to be sacrilege to open up a corpse, he carried out thirty dissections, an enormous number under the circumstances, considering that discovery could have meant trial and imprisonment or even death. With delicate saws which he himself had made, he opened up the corpse of an old man which he had carefully chosen 'because it was free from fat and the juices which prevent one from recognizing the various organs'. Moreover, he was the first to observe the phenomenon of arterio-sclerosis – 'chestnut-size petrifications, the colour of truffles, in the veins'. He portrayed the skeleton and the muscular system; his drawings of the veins in the arms, chest and abdomen are so graphic that it is believed that he must have used wax injections such as were developed by the great Dutch anatomists, Albinus and Ruysch, in the seventeenth century. In his drawings of the heart-valve functions, intimations of the idea of blood-circulation, discovered by Harvey, have been discerned. He did research in embryology, drew a famous diagram of the reproductory system and, as if creating an artistic version of these researches, composed a picture of Leda as goddess of fertility and symbol of the power of nature, which, in the form of her children, Castor and Pollux, issuing from the eggs, and above all in the plants which he painted here more richly and lovingly than anywhere else, greatly outshines the nude figure which appears to have been distasteful to him. He even planned a comprehensive work on anatomy which would describe man from his procreation to his death. Proud, yet self-aware, he begins: 'I choose to work miracles. Yet if one follows such studies one earns less than the people who live a calmer life and make it their aim merely to become rich . . .' The work was never finished, but the drawings continued to exert a wide influence, reflected perhaps in the publication several decades later of the famous work by the anatomist Vesalius, with which he founded an entirely new scientific discipline.

Three years in Rome: Leo X, of the Medici family, was now Pope, and his brother Giuliano accommodated Leonardo in an apartment in the Belvedere, The Pope was impatient, like all men who accede to high office at a late age

John the Baptist. **Oil painting by Leonardo**